

JOURNAL
OF THE
ROYAL
SOCIETY OF ARTS

VOLUME LXXVII.

FROM NOVEMBER 16, 1928. TO NOVEMBER 8 1929

29808 / 36

LONDON ·

PUBLISHED FOR THE SOCIETY BY G. BELL & SONS, LTD.,
YORK HOUSE, PORTUGAL STREET, LINCOLN'S INN FIELDS, W.C. 2.
1929.

LONDON:

PRINTED BY F. J. PARSONS LTD., 237-241, BANK CHAMBERS, 329 HIGH HOLBORN LONDON W C 1 AND
"OBSERVER" BUILDINGS CAMBRIDGE ROAD HARTING'S

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 3989.

VOL. LXXVII.

FRIDAY, MAY 3rd, 1929.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.(2.)

NOTICES.

NEXT WEEK

MONDAY, MAY 6th, at 8 p.m. (Aldred Lecture.) SIR E. DENISON ROSS, C.I.E., Ph.D., Professor of Persian and Director of the School of Oriental Studies, University of London, "Nomadic Movements in Asia." (Lecture III.)

WEDNESDAY, MAY 8th, at 8 p.m. (Ordinary Meeting.) CHARLES J. FOULKES, O.B.E., F.S.A., Curator of the Armouries, Tower of London, "War and the Arts." PROFESSOR W. ROTHENSTEIN, M.A., Principal, Royal College of Art, will preside.

FRIDAY, MAY 10th, at 4.30 p.m. (Sir George Birdwood Memorial Lecture.) CAPTAIN P. JOHNSTON-SAINT, M.A. (Cantab.), F.R.S.(Edin.), I.A.(retd.), of the Wellcome Historical Medical Museum, "An Outline of the History of Medicine in India." SIR E. DENISON ROSS, C.I.E., Ph.D., will preside. The lecture will be illustrated by lantern slides.

Tea will be served in the library before the meeting from 4 o'clock.

NINETEENTH ORDINARY MEETING.

WEDNESDAY, APRIL 24th, 1929. PROFESSOR T. PERCY NUNN, M.A., D.Sc., Litt.D., in the Chair.

A paper on "Recent Developments in Educational Broadcasting" was read by MR. LYNTON FLETCHER, B.A., of the British Broadcasting Corporation. The paper and discussion will be published in the *Journal* on June 28th.

ALDRED LECTURES.

MONDAY, APRIL 29th, 1929. SIR E. DENISON ROSS, C.I.E., Ph.D., Director of the School of Oriental Studies, University of London, delivered the second of his course of four lectures on "Nomadic Movements in Asia." The lectures will be published in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

TENTH ORDINARY MEETING.

TRUEMAN WOOD LECTURE.

WEDNESDAY, FEBRUARY 6TH, 1929.

E. F. C. TRENCH, Esq., C.B.E., M.Inst.C.E., Consulting Engineer to the L.M.S. Railway, in the Chair.

THE CHAIRMAN said that Sir Alfred Ewing required no introduction from him; few men were so well known among engineers and others engaged in the work which was the subject matter of the lecture. He had sat under Sir Alfred's Chairmanship now for several years in connection with the Bridge Stress Committee, and he could assure the audience that if they were as interested in what Sir Alfred had to tell them as the Committee had been in the work which Sir Alfred had made them do, they would be exceedingly fortunate.

The following lecture was then delivered. —

THE VIBRATIONS OF RAILWAY BRIDGES: AN EXAMPLE OF CO-OPERATIVE RESEARCH.

By SIR J. ALFRED EWING, K.C.B., M.A., LL.D., D.Sc., F.R.S., M.Inst.C.E., Principal and Vice-Chancellor of the University of Edinburgh, and Chairman of the Bridge Stress Committee.

Since the Spring of 1923, nearly six years ago, it has been my privilege to preside over the Bridge Stress Committee, which was then appointed to deal with an old and puzzling problem of engineering—what is called the "impact" or dynamic action of a train moving at high speed over a railway bridge. When I was invited to deliver this lecture, founded in memory of your honoured former Secretary, whose recent death is deplored by his many friends, it seemed suitable that I should take occasion to speak about the Committee's work. It deals with a question that naturally comes within the ambit of the Society's interest—a question where practice seeks illumination and guidance from theory. As it happens, the occasion is particularly opportune, for the Report of the Committee—a voluminous and in all senses a weighty document—has just been published. In dealing with so intricate a matter in a single hour I cannot do more than touch briefly on some of the more salient points.

First, I would have you notice that this research is of a kind that could not have been achieved without co-operation. Its parent was the Department of Scientific and Industrial Research, which brought together the British railway

groups, securing not only their goodwill and their financial help, but also all the practical facilities without which the experiments could not have been carried out. The Committee was constituted and has done its work under the auspices of the Department. It included engineers of experience and experts in theory, persons well fitted to plan the experiments and to analyse the results. We were very happy, I venture to say, in our personnel: among our members was Mr. Trench, who is in the chair to-night, recently President of the Institution of Civil Engineers. He, with Mr. Brown, Mr. Ellson and Mr. Cookson, represented the four great railway companies of the island, which, as a good Scotsman, I must not call England. Then we had Sir Robert Gales, member of a well-known firm of consultants; also Prof. Dalby, Prof. Inglis and Mr. Southwell—experts who have not forgotten their mathematics. And we had Colonel Sir John Pringle, whose unrivalled knowledge of the misadventures of railways gave his advice particular emphasis and value. A report signed by Sir John Pringle is not likely to contain recommendations that are unduly rash.

We soon realised that our problem involved questions of locomotive design and the conditions that govern it. The Committee was accordingly strengthened—greatly strengthened—by the addition of Sir Henry Fowler. We also saw that it was necessary to undertake an extensive series of tests of railway bridges; so our first act was to set up a staff of engineers. About a dozen young engineers were selected—products of the admirable teaching which young engineers now enjoy—and at their head we placed Mr. Conrad Gribble, of whom the Report most truly says that his intimate knowledge of bridge design is only one of many qualities which have combined to make him an exceptionally suitable head of such an enquiry. To myself the close association with the members of the Committee and with Mr. Gribble and his staff during the long process of carrying out the experiments, discussing the significance of results, and settling the terms of the Report, has been an unqualified pleasure. Rarely, I think, can it have happened in the history of committees that one composed of elements so various and engaged in an enquiry so protracted and so difficult, has found its members' interest equally well sustained from start to finish, and has in the end issued a wholly unanimous Report.

The impact, as it is called, of a moving load is an old problem. As a young student of engineering more than half a century ago I used to be taught the simple rule that for a moving load you had simply to multiply by two. Simplicity is the only virtue of that exceedingly fallacious rule. It is easy enough to see how such a rule was framed. Think of a spiral spring hanging from a fixed support, and what happens when you suddenly hang on a load. Down goes the load, and after a series of oscillations, it settles in a mid-position, just half as far down as it went at first. You have there a quite obvious example of the simple rule. But it would be a fallacy to apply that

to a railway bridge. A bridge does not dip twice as far when a train is passing as when the train stands upon it. Still, there is a well-founded engineering instinct that there ought to be some allowance for impact; that the swiftly moving load, somehow or other, does produce a dynamic effect which makes an addition to the stress that would be experienced if the load were standing on the bridge, or crawling over it.

Let me explain at the outset that we are not dealing here with any question of fatigue. We are dealing simply with the question, what additional stress do the members of the bridge have to bear because the load is moving, and also (this is highly important) because within the load itself there are parts that are moving relatively to one another. Early consideration of the problem by American bridge-builders gave rise to what is known as the Pencoyd formula, according to which you should add a certain fraction of the moving

load as an allowance for impact. The rule was to add the fraction $\frac{300}{300+L}$, where L is the span in feet. Obviously if L is very small this fraction is near unity. In other words, with a very short bridge the Pencoyd rule means doubling the applied load. On the other hand, as L gets longer the fraction gets less, and if the span were 300 feet the fraction to be added would be just one half.

There are many similar formulas involving much the same idea but different in their particular numerical values. All such formulas are fundamentally unsound. The fact is that a perfectly smooth rolling load running over a bridge on smooth rails would cause almost no impact effect at all. That has been shown by the theoretical investigations of Prof. Inglis, whose services to our Committee I cannot overrate; and the validity of his theory has been demonstrated time and time again in the course of our experiments.

Why is it, then, that in a railway bridge a substantial amount of oscillation is in fact set up during the passage of a train? Mainly—almost wholly—because of the hammer-blow of the locomotive. The phrase “hammer-blow” is one with which, I imagine, most of this audience are familiar. It is a periodic variation of the vertical force exerted on the rails by the locomotive, which arises from the fact that balance weights have been put in the wheels for the purpose of neutralising to some extent the horizontal momentum of reciprocating parts, such as the pistons, piston rods, and connecting rods, which would otherwise tend to cause a horizontal swaying of the locomotive. The presence of the balance weights gives rise to a sinusoidal variation of vertical force which, in extreme cases, may be as much as 25 tons, alternately added to and subtracted from the actual weight of the engine. We made many experiments with a locomotive in which even that figure was exceeded.

Much may be done to reduce this hammer-blow by a careful consideration of the balancing problem, even in a two-cylinder engine, and still more may be done to reduce it by using three or four cylinders instead of two. Mr. Gresley's

powerful "Pacific" engines, for example, which were in service on the L.N.E. Railway before our enquiry began, illustrate well how much may be done to avoid hammer-blow by the judicious use of three cylinders.

It is pleasant to know that while our conclusions were still unpublished, we were able, chiefly through the intermediary action of Sir Henry Fowler, to bring them to the notice of locomotive designers, with good results upon existing practice in the matter of escaping excessive and quite unnecessary hammer-blow.

Among previous investigations of the same general question mention should be made of the experiments of the American Railway Engineers' Association, whose Report was published in 1910, and the work of the Indian Railway Board, which extended from 1917 to 1921. Those enquiries established the importance of hammer-blow, but they were not carried far enough to give working rules of a satisfactory kind for the guidance of railway engineers.

In the course of our experiments we tested fifty-two bridges of all sorts, with spans ranging from 16½ ft. up to 345 ft. Over these we ran a variety of locomotives, lent, of course, by the railway companies, and selected to exert various amounts of hammer-blow, some of them giving specially large amounts. We used several forms of deflectometer and strainmeter. For strainmeters, to be attached to the members, we had, in particular, two types—the Fereday-Palmer type, and another type devised by the Cambridge Scientific Instrument Company. In the Fereday-Palmer instrument the recording is photographic, and very effective it is. In the Cambridge Instrument Company's instrument, a method invented by a member of that firm, Mr. Collins, is used, according to which a fine point scribes, with very little friction, a line upon a moving strip of photographic film. The recording is mechanical; there is no photography in the process. We also used in a few experiments an electric form of strainmeter devised by Mr. Thomas, of the National Physical Laboratory, and modified in its application to our purpose by Mr. Moullin. It was specially valuable as an instrument of comparison, for checking errors in the other types that arose from the inertia of their mechanical working parts. As for deflectometers, the problem is comparatively simple. There again we used the Collins method of recording on a moving strip of photographic film, but it was a purely mechanical record. We found no serious difficulty in getting a deflectometer to record with accuracy every phase in the movement of the middle of the bridge. I do not intend to take up the short time at my disposal by dealing with details of instruments, and the checking of instruments. You will find that fully gone into in the Report.

Now, what is the action of the hammer-blow? The essential characteristic is that during the passage of the load you have superposed upon the gravitational action of the moving weight an oscillating variation of vertical force, whose complete period is represented by a distance equal to the circumference of the driving wheels. Lord Balfour, in his introductory note to the Report,

compares this action very appropriately to that which occurs when a man wheels a barrow across a plank. The plank has a natural period of vibration. When the man and the barrow are on it, it still tends to vibrate, but in a slower period, because it is now more heavily loaded. If the barrow could move without the man you would have an extremely smooth deflection of the plank with no vibration to speak of; but the action of the man's feet produces much the same effect as the hammer-blow of a locomotive; and so you have the plank set into oscillation. Everybody knows that in such a case the effect may be immensely increased, if the plank is a long one, by resonance; that is to say, there may be a cumulative effect arising through synchronism between the period of the man's steps and the natural period of oscillation of the loaded plank. The same thing is true of the loaded bridge. A bridge loaded with a locomotive and train has a fairly well-defined natural period of oscillation. Obviously, unless the bridge is an excessively short one, it will frequently happen that the locomotive is crossing at just the speed which is fitted to make its periodic hammer-blows produce resonance. In a very short bridge this will not occur, because there, even with the load on it, the bridge tends to vibrate more quickly than any frequency of hammer-blow that can be reached in the motion of the locomotive. The highest frequency that is reached in express running is something like six periods per second. We dealt with some bridges so short that the natural frequency of vibration was more like 10 or 12 per second. In a case such as that there can be no resonance, because the bridge has too high a natural frequency, but when the span is more than 30 ft. or so some resonance is liable to occur. When you get up into the region of 100 to 200 ft. span, you may have immense developments of resonance, and it is in such bridges that the greatest impact effects are found. With longer spans still—although there may still be resonance—it occurs only when the speed of the train is so slow that the hammer-blow is small, and therefore it becomes comparatively unimportant. It is in the middle region of spans, especially the region between 100 and 200 ft. or thereabouts, that the effects of resonance are most serious.

I shall begin by showing some complete typical diagrams, as we got them in our recorded tests of the deflections of bridges. I ought first to say that we made many measurements of stress as well as deflection, but we found that the accordance between deflection readings and stress readings in the main tension and compression members was so perfect that deflection readings were quite enough for the purpose. It was only in dealing with web members, to ascertain the influence of impact on the shearing stresses, that we had to resort to stress measurements, because there, of course, deflection by itself did not tell us anything.

Figures 1 and 2 are typical examples of the recorded deflection when a locomotive passes over a bridge. In Fig. 1 the bridge is a fairly long one (about 170 feet), and is set into resonant oscillation because it has a natural

period which agrees with the period of hammer-blow ; in other words, the engine is running at what we call the *critical* speed. In Fig. 2 the bridge has a span of only about 30 feet and is too short to develop resonance, but the engine is running at a high speed and each hammer-blow produces a well-marked individual effect. Both figures show the deflection at the middle of the bridge in relation to the time. On the left the curve begins to dip when the front wheels of the locomotive enter the bridge. On the right the dip

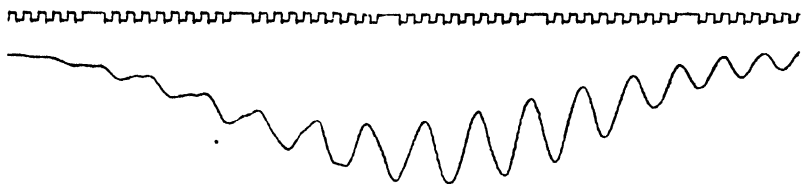


FIG. 1.—Typical record of the Deflection of a Bridge during the passage of a locomotive at the critical speed

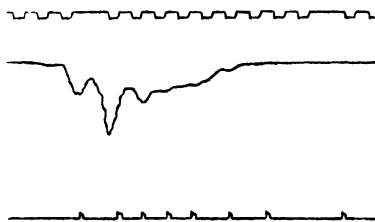


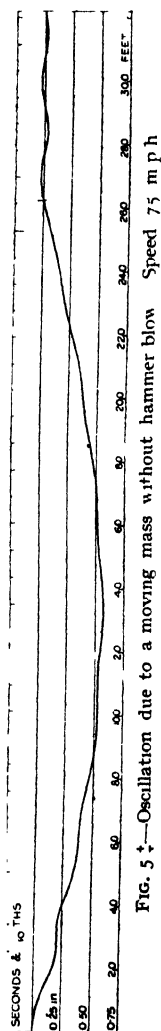
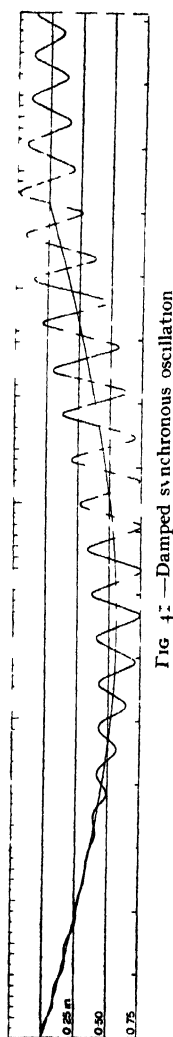
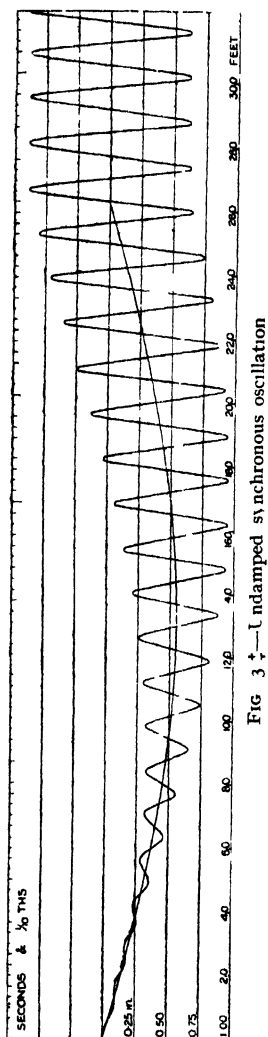
FIG. 2.—Record of Deflection of a short bridge during the passage of a locomotive at high speed.

ceases when the last wheels of the tender leave the bridge, but you observe that in Fig. 1 the bridge is left oscillating after the engine has passed off. The time scale at the top of each figure shows tenths of a second, each complete second being indicated by the omission of the tenth mark. The length of the deflected portion in each figure corresponds to the span plus the wheel base of the locomotive and tender. Notice in Fig. 1 the gradual building up of oscillation, which reaches its maximum soon after the engine has passed the middle of the bridge. The residual oscillation seen on the right would soon disappear through the influence of damping if the record were continued. In Fig. 2 the engine also enters from the left and you see three well-marked dips which are direct effects of heavy hammer-blows on a short and rather flexible bridge. After that, no more hammer-blows are felt, for the driving wheels have passed off and the remainder of the curve is due to the tender. The locomotive used here was of the 0—8—0 type, with much hammer-blow. Its four coupled pairs of drivers had a wheel base of about 15 feet. In the first of the three blows, the leading drivers were operating, in the second all

four are felt, and the third blow comes as the last pair were about to pass off. The remainder of the diagram is the deflection of the bridge under the tender. There is practically no resonance in Fig. 2. Each blow simply produces a dip proportional to the blow itself. It may be said to act as a static force without any dynamic magnification. In Fig. 1, on the other hand, there is much dynamic magnification. The blows are individually lighter, for the speed of the engine is less, but they produce a cumulative effect that comes from the synchronism between their period and the natural period of the bridge. Towards the end the vibration becomes reduced, partly because of damping and partly because the natural period of the bridge alters, becoming quicker as the locomotive is passing off.

Let us now consider the development of resonant vibrations under the influence of synchronous hammer-blows. In Figs. 3, 4 and 5 are a group of theoretical deflection curves, calculated by Professor Inglis for a bridge having the same span and natural period of vibration as one of those which we actually tested. He has also taken for hammer-blow the amount that was delivered by one of the engines which were used in the tests. In Fig. 4 he shows how oscillations would be developed if there were no damping, and if the bridge retained a uniform period of oscillation which agreed with the period of the blows. In Fig. 4 he shows how the result is affected by damping, that is to say, by a dissipation of energy such as actually occurs in any bridge set into oscillation; and in Fig. 5 he shows the kind of oscillation which would be set up by a single mass of the same weight running smoothly across the bridge at a high speed without any hammer-blow. By comparing these figures you will see (1) what a very small amount of oscillation is caused when there is no hammer-blow, and (2) what immense effects the hammer-blow may cause when the conditions are favourable for resonance.

Why then is it that we do not have a really dangerous amount of oscillation developed in railway bridges? It is mainly for two reasons: first, because there is never a perfectly sustained synchronism for any long time. While the locomotive is crossing the bridge the natural period of oscillation necessarily changes. When the heavy mass is at the middle, the oscillation is slower than when the locomotive is just entering or just leaving. This variation in the period of the loaded bridge itself does much to check the building up of resonant oscillations. Again, there is the influence of damping, which arises from several different causes. The bridge is not a perfectly elastic structure. If one end is held fixed, the other end slides backwards and forwards when the bridge oscillates, and its sliding is opposed by friction. Further, any oscillation that is set up in the bridge is communicated through the piers to the surrounding ground. You have only to stand near a bridge when a train is passing to be aware that energy is being communicated to the ground under your feet. There is still another cause of damping which, as our investigations have shown, is of immense importance, namely, the damping that occurs within



the train itself through the action of the springs. In a locomotive the chief part of the mass is carried on stiff springs that work with considerable friction, and when the oscillations of the bridge become sufficiently violent these springs are set into action. This affects the natural period of the bridge.

† Reproduced by kind permission of the Secretary of the Royal Society from a Paper on "Oscillations in a Bridge caused by the Passage of a Locomotive" by C. E. Inghs (Proc Roy Soc A Vol 118, 1928)

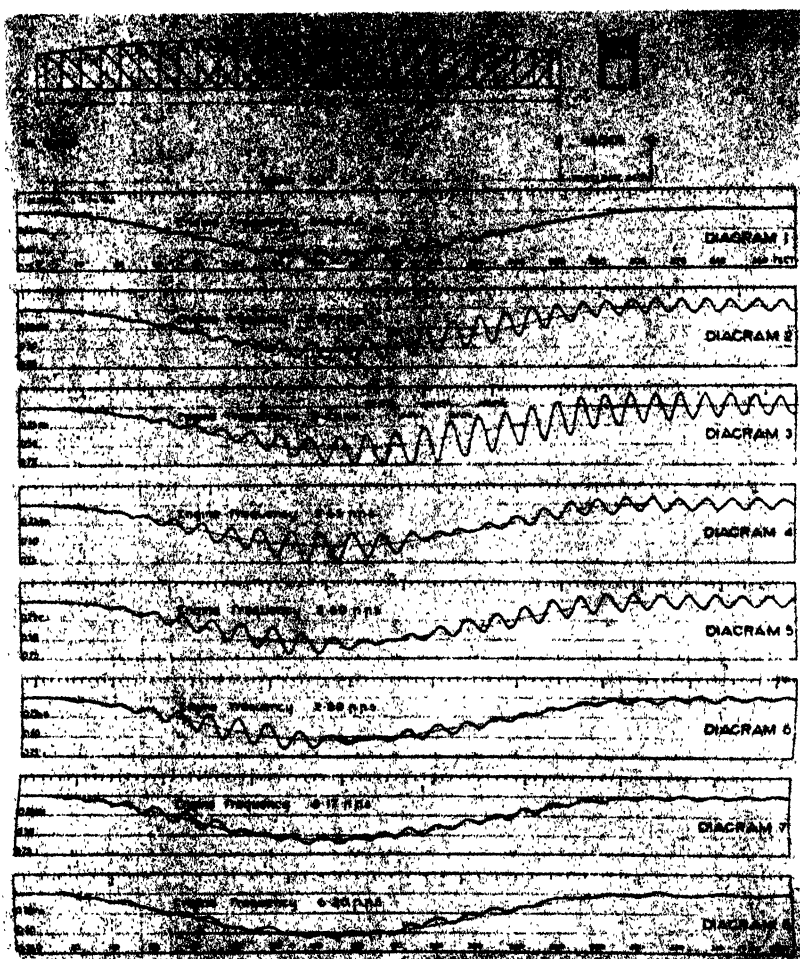


FIG. 6.—Records of Deflection of Newark Dyke Bridge for a locomotive passing at various speeds.

oscillations, and it also introduces a supplementary kind of damping which is very influential in preventing excessive oscillation on the part of the bridge.

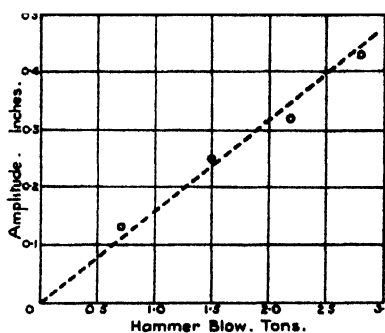
Figure 6 shows a series of tests of a bridge at Newark Dyke of 262 feet span, carrying a single track symmetrically placed between two girders. The deflections of both girders were found to be in perfect agreement. The figure contains a series of diagrams showing the effect of running a heavy goods locomotive with 4ft. 6in. driving wheels over the bridge at various speeds—

first at a speed less than that corresponding to synchronism, then at speeds favourable to resonance, and so on up to speeds very much higher. You will see that when the engine frequency is 2.14 periods per second there is comparatively little resonance. There is more when the engine frequency becomes 2.3, and much more when it becomes 2.4. Then when it is increased to 2.55, the resonance is greatly less, and it diminishes with further increase in the speed until at 6.2 periods per second very little oscillation is seen, although at that high speed the actual hammer-blow is more than six times greater than it was at the speed of 2.4, when the resonant oscillations were so large. A comparison of these diagrams shows that 2.4 periods per second is the critical speed, at which resonance is much more marked than when the speed is either higher or lower. This action is typical of any long bridge.

In another test we ran engines of five different types, with various amounts of hammer-blow, across a bridge of 210 feet span, in order to test the correspondence between the amount of hammer-blow and the amount of oscillation produced. Each of the engines was run at the critical speed, that is to say, at the speed best adapted for producing resonance, and we found, under these conditions, that there was a close proportionality between the amount of the hammer-blow and the amount of cumulative oscillation which became set up in the bridge.

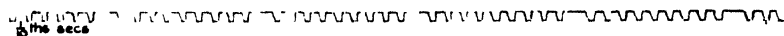
In the course of our experiments we constructed an oscillator for the purpose of setting bridges into oscillation without the passing of a locomotive. The bridge oscillator consisted of a truck carrying a frame on which was mounted a pair of geared axles running in opposite directions and carrying heavy weights, which could be varied in amount. The weights were placed out of centre so that in the course of their revolution they imitated the effects of hammer-blow, but without any movement on the part of the truck which carried them. They were electrically driven, with the truck clamped to the rails at or near the middle of the bridge. We could place this on a bridge and could either test the bridge without other load or could have a locomotive standing near so as to make the condition of loading the same as when the locomotive was passing over. By varying the amounts of the revolving mass we could vary the hammer-blow to any desired extent. Figure 7 shows a set of four records taken with this oscillator on a bridge of 210 feet span. The revolving masses were changed from 100 lbs. to 200, 300, and 400, and were in each case run at the critical speed so as to produce all the resonance possible, giving amounts of hammer-blow equivalent to a range from 0.7 to 2.8 tons. The diagram shows that, within the limits of experimental error, the amplitude of oscillation is proportional to the hammer-blow.

The bridge oscillator exhibited very directly the effects of damping. A constant state of oscillation was established when the energy put in by the oscillator was being dissipated by the bridge at the same rate. Further, the oscillator was of great service as a means of measuring the frequency of the bridge, both in its loaded and unloaded state.



Deflections of near girder.

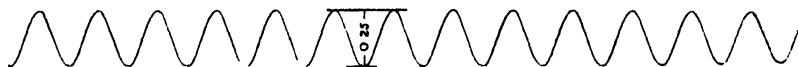
100 lbs wt 3.60 pps. 0.71 tons H.B.



Revs.

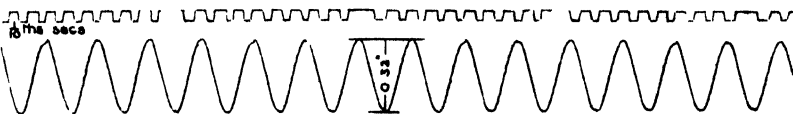
200 lbs wt 3.69 pps. 1.49 tons H.B.

1/10ths sec.



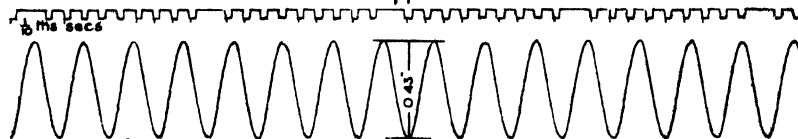
Revs.

300 lbs wt 3.65 pps. 2.19 tons H.B.



Revs.

400 lbs wt 3.58 pps. 2.81 tons H.B.



Revs.

FIG. 7.—Action of Bridge-oscillator.



FIG 8* — Model bridge

Figure 8 shows another appliance which was of considerable service—a model bridge built by Professor Inghs in his laboratory at Cambridge consisting of a pair of rails extending over a span of 12 feet. Across it passed a little truck which was accelerated by a falling weight and ran over the bridge at a constant speed. The deflections were registered as it passed and hammer-blows were produced by having in the truck a pair of geared wheels with

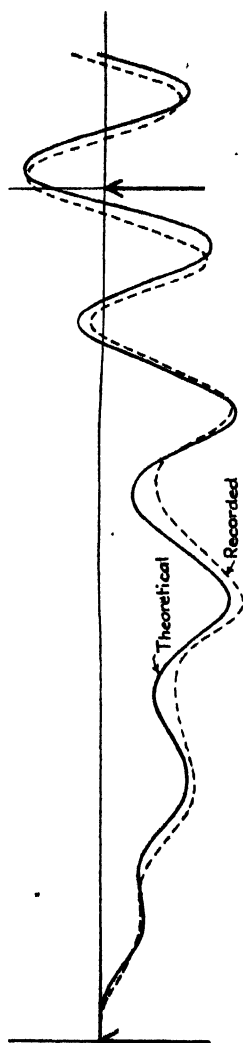


FIG. 9*.—Comparison between theory and experiment for model bridge.

revolving weights. The model was adapted to be the equivalent, on a reduced scale, of one of our actual bridges. With its help, Professor Inglis obtained extremely satisfactory confirmation of his calculations regarding the building up of the hammer-blow effects in actual bridges. Figure 9 shows a comparison

Reproduced from the Report of the Bridge Stress Committee by kind permission of the Controller, H.M. Stationery Office.

between the observed deflection of the model bridge and the deflection as calculated from theory, taking account of damping. A coefficient of damping had, of course, to be assumed. It was only by the selection of a suitable coefficient that this close correspondence between theory and observation could be achieved.

By similar computations Professor Inglis was able to work out theoretical diagrams for the Newark Dyke Bridge under various frequencies of hammer-blow, and these showed a satisfactory agreement with the observed curves exhibited in Figure 4. One very interesting point may be mentioned. In the diagram at 2.4 periods per second, Professor Inglis' calculated curve showed less sustained vibration as the locomotive was passing off than was shown in the record of the test. Professor Inglis at once felt sure that there must be something a little wrong with that experiment. He was quite right. It turned out on closer investigation that the engine had accelerated after passing the middle of the bridge, and had run off at a speed somewhat higher than 2.4 p.p.s. By this means it kept itself in closer synchronism while the bridge changed from the loaded to the unloaded condition, and that is why the oscillations while the engine was passing off are larger than they would otherwise have been.

Passing over other typical records (which were shown on the screen), let us look at Figures 10, 11, and 12, which show the amplitude of oscillation with reference to the frequency of the hammer-blow. These are called frequency-amplitude diagrams. In a long bridge such a diagram takes the simple form shown in Figure 10. There is a sharp peak at the critical frequency, with a rapid falling away at frequencies which are either greater or less. That is illustrated by the results for the Newark Dyke Bridge, the span of which is

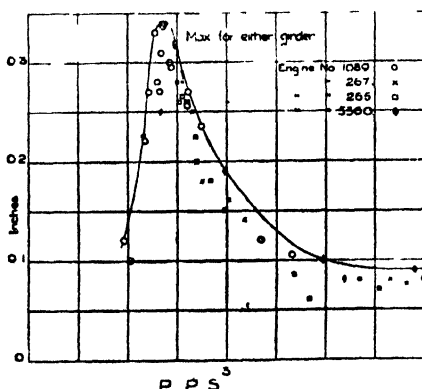


FIG. 10*.—Frequency-Amplitude Diagram for tests of Newark Dyke Bridge (Span 262½ ft.)

* Reproduced from the Report of the Bridge Stress Committee by kind permission of the Controller, H.M. Stationery Office.

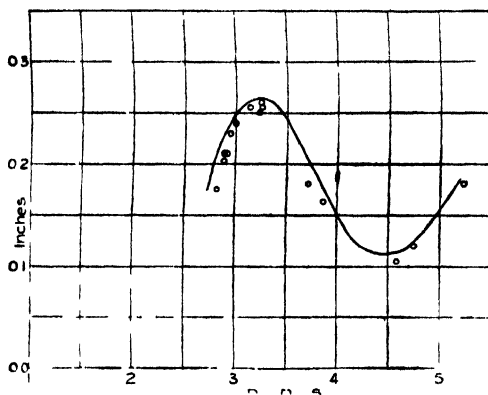


FIG 11*—Frequency-Amplitude Diagram for tests of River Aire Bridge (Span 210 ft)

262½ ft. There is a definite tailing off in the amplitude of oscillation up to the highest speeds included in the trials

But when we turn to a somewhat shorter bridge we find that at high speeds there is a tendency for the amplitude to begin rising again. This is well illustrated by Figure 11, which relates to a bridge of 210 ft. span over the River Aire. You see that after passing the critical speed, and going down to a comparatively small amount, the oscillation begins again to increase very distinctly, although even at express speeds it does not increase so much as to exceed the amplitude it showed at the critical speed. It was found that this effect was exhibited more by some locomotives than by others. One of the most puzzling things with which we had to deal was to get at the true inwardness of this tendency on the part of the oscillation to rise at high speeds, long after the critical speed had been passed.

A much more marked effect of the same kind is found when you test a shorter bridge. In Figure 12 we have frequency-amplitude curves for a bridge at Langport East of 112 ft. span, showing effects with different types of locomotives. Here there are still some traces of an early critical point, but after that has been passed and the speed has got a good deal faster the oscillation continues to develop and gets bigger and bigger, so that at the highest speeds it very much exceeds that which was experienced at the critical point. You will see in these diagrams that the biggest effects are found at the highest speeds, although at an earlier stage there has been something in the nature of a critical point, especially with locomotive K. There is at least a well-developed shoulder before the final rise of amplitude begins. How is that characteristic produced? This is a problem which Professor Inglis solved by his mathematical discussion of the matter. He found it was due to the influence of the locomotive springs,

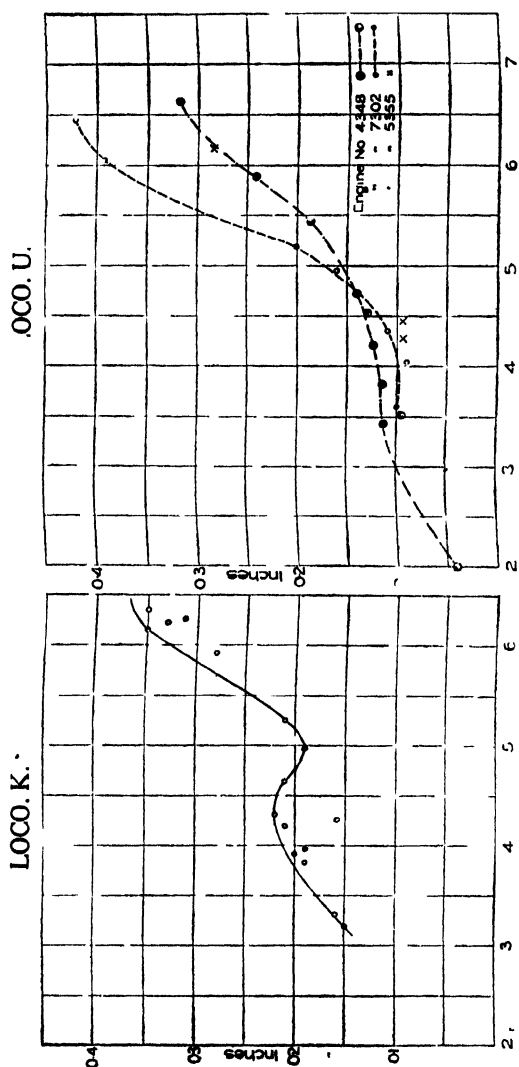
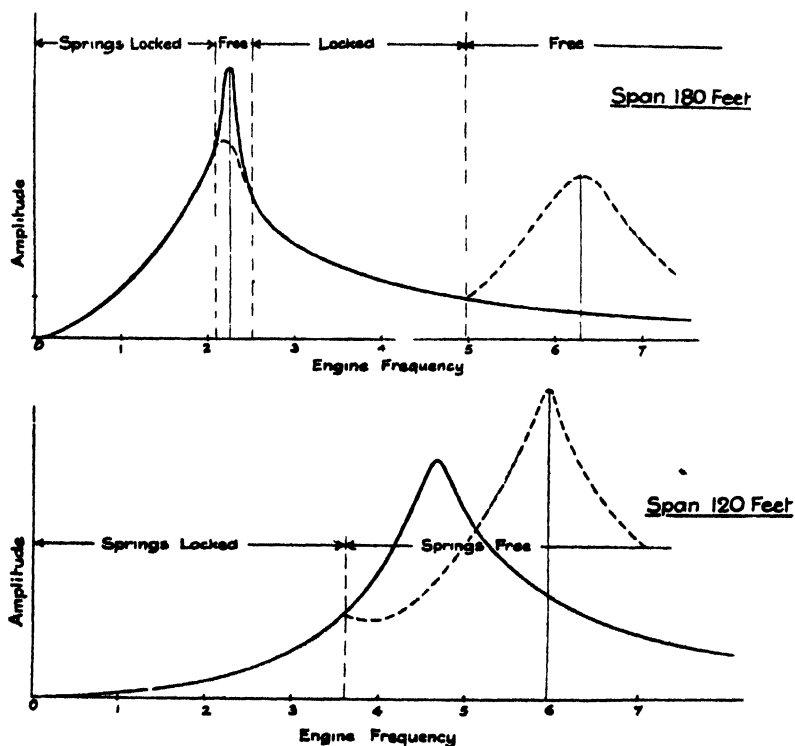


FIG 12 *.—Frequency-Amplitude Diagram for tests of Langport East Bridge (Span 112 ft)

that is to say, to the development of mobility within the locomotive itself when its springs came into play. At low speeds the locomotive is moving as a whole. The springs are not in action ; but, as the speed increases, they come into action. That is the essential cause of the further rise in amplitude of oscillation. The difference in effect between one locomotive and another is

that in one the springs are stiffer and only come into action when the oscillations become more violent.

Figures 13 and 14 will make the reason plain. They are theoretical diagrams worked out by Professor Inglis, and they illustrate his theory of what happens when the springs of the locomotive become unlocked. In both of these figures the full line shows what would happen if the locomotive springs were to remain locked, and the broken lines show what happens when the springs come into action. He takes in Figure 13 an imaginary bridge of about 180 ft. span, and uses the coefficients which we had determined by means of our experiments



FIGS 13 and 14.—Effects of locomotive spring movement on Frequency-Amplitude Diagrams, in bridges of different spans, as calculated by Professor Inglis' theory

with such a bridge. He finds that if the locomotive springs were to remain completely locked you would get the high peak exhibited by the full line of the diagram—the early critical point. The springs may become unlocked at

*Reproduced from the Report of the Bridge Stress Committee by kind permission of the Controller, H.M. Stationery Office

this stage, which gives to the peak a lower height indicated by a broken line, but as the speed rises and the oscillation becomes less, the springs become locked again, and remain locked until a much higher speed is reached. In Figure 13 the peak occurs at a frequency of about $2\frac{1}{4}$: the springs become locked again at about $2\frac{1}{2}$ and remain locked until the frequency rises to 5 or so. Then the springs become again unlocked and remain unlocked, and that is the cause of the subsequent rise which, in this example, gives a second critical point when the frequency is a little over 6, as is shown by the broken line. In this example, the second critical point gives an amplitude rather lower than the first. But with the shorter bridge shown in Figure 14, where the span is about 120 ft., you will observe that the locomotive springs become unlocked at a frequency of about 3.6 and remain unlocked, thereby causing the amplitude of oscillation to vary in the manner shown by the broken curve, with the result that the greatest oscillation occurs at a frequency of 6, after passing a definite shoulder in the region between 3 and 4. That is exactly the kind of action which we had observed in the Langport East Bridge (Figure 12). Thus it is seen that when the unlocking of the locomotive springs is taken into account, a complete theoretical explanation is obtained of the very complicated and puzzling effects which had been observed in our trials of actual bridges. I have dwelt on this point because it is the most distinctive contribution to engineering theory which we have been able to make, and it is of fundamental importance in determining the proper value of impact allowances. The credit for it is due to Professor Inglis.

In this way we have been able to solve the problem of the hammer-blow. It has been a long and complicated business; much more complicated than we anticipated when we began the enquiry. The general principles being established, it was comparatively easy, although it took a good while, to work out the maximum amount of impact effect which should be allowed for when the amount of loading and the amount of hammer-blow are specified. You will find Professor Inglis' theory set out in mathematical form in the Report, along with an Appendix which shows how the calculations are made, and in the body of the Report tables are given of numerical results applicable to English railways.

Besides the hammer-blow effects there are one or two minor features of impact which require to be taken into account. First there is the action of rail-joints. On a short bridge it is possible to avoid rail-joints, and it is very desirable that they should be avoided, because they may give a supplementary kind of impact which has to be added to the effect of the hammer-blow. As a general result of our experiments we give a simple rule for the addition which it is proper to make in order to provide for the rail-joint effect. This allowance is extended to include the effect of accidental irregularities in the track.

Then there is another minor impact effect which a locomotive is liable to produce through its tendency to what we call "lurching." This means a

tendency to oscillate about a horizontal fore-and-aft axis, which has the effect of throwing upon each rail alternately a larger share of the load than the half which each rail should bear. We have estimated an additional allowance to provide for that, and in this way, the total allowance is reached which, in our opinion, provides adequately for impact.

For the purpose of railway bridge design it is usual to state the loads which a bridge has to carry in terms of what is called the "equivalent uniformly distributed load." Similarly, the aggregate effects of impact may be expressed also as an equivalent uniformly distributed load. This may seem a little odd, but when you come to think of it, it is natural enough. While a loaded train is passing, the bridge, however severely it is oscillating, has at any instant a particular curvature due in part to the weight of the loads, and in part to the impact effects. You could imagine the bridge standing still with just that curvature, if you think of the instantaneous substitution of a suitably distributed load for the actual passing load. The distributed load so imagined would be acting statically, but it would hold the bridge in the state of maximum deflection which actually occurs during the passage of the train. Now the form in which the bridge is held deflected will be very nearly the same whether you take that imaginary load as uniformly distributed, or take it as distributed in the complex manner which would correspond to the actual loads and the actual effects of hammer-blow. The difference as regards bending moments is so trifling as to be unimportant. It is, in fact, very convenient, and not open to any objection, to substitute for the calculated impact effect an estimated uniformly distributed load. The Tables which we give in our Report state in that manner the total load to be provided for by adding the impact effects to the estimated weight of the passing load.

For the purpose of making these numerical estimates it was necessary to adopt some standard of loading. We adopted the standard laid down by the British Engineering Standards Association, which has now received the sanction of the Ministry of Transport. That standard assumes a train with two locomotives, each having four pairs of wheels in the engine and four in the tender. The unit is one ton on each axle of the engine, and three-quarters of a ton on each axle of the tender, and after the second locomotive there is supposed to be a following train in which the unit is one-tenth of a ton per foot run. How many of these units ought to be taken to represent the weight of the train which the bridge may have to carry? It appears from an examination of the weights of locomotives now in service that 17 or 18 of these units represent the maximum that occurs in actual British practice. But to provide for the heavier weights which may be reached by the use of three and four-cylinder locomotives 20 such units are specified by the Ministry of Transport. We adopt that, taking the heaviest trains as representing 20 of these units. Next comes the point: What amount of hammer-blow is to be provided for? To answer that, we collected statistics regarding the locomotives now in use. We finally

came to the conclusion that for the 20-unit trains of the future it will be quite sufficient to allow 5 tons of hammer-blow, measured at the conventional speed of 5 revolutions per second. That is for the heavy locomotives which are coming into use with three or four cylinders; but for the vast number of two-cylinder locomotives still in use, and likely to remain for a long time in use, we considered that a 16 unit loading with $12\frac{1}{2}$ tons of hammer-blow should be allowed. And, further, there are some lighter engines now running which correspond to a 15 unit loading but have as high a hammer-blow as 15 tons. We call these loadings A, B, and C, respectively. Loading A is 20 units of weight with a 5-ton hammer-blow; loading B is a 16 units of weight with a $12\frac{1}{2}$ ton hammer-blow; loading C is 15 units of weight with a 15 ton hammer-blow. We consider that loadings A and B should be provided for in all cases, and that loading C should also be provided for on any lines where engines with that objectionably heavy hammer-blow are still liable to run.

Then came a further question. How far is it necessary to provide for the simultaneous effects of hammer-blow in more than one engine when there is double-heading, or where trains are passing on a double-track bridge? What of the possibility that the engines may be exerting their hammer-blows with a complete agreement in phase, so that the bridge experiences the utmost possible effect? Our calculations provide for certain contingencies, which are definitely set forth in the Report. In single-track bridges which are long enough for two engines, we provide for the possibility of both engines being in phase. In double-track bridges that are long enough for one engine only, there might be two engines passing one another and agreeing in phase. In double-track bridges long enough to take two engines, you might have four on the bridge together, two on each line, but our calculations assume that of the four only two will be in phase. In other words, the excessively remote contingency of more than two being in phase at the instant when they are cooperating to produce the greatest bending moment is left to the factor of safety. On this basis Professor Inglis and his assistants calculated a series of curves exhibiting the estimated impact effect on bridges of various spans from the shortest to the longest. In figures 14 and 15 you see two examples of the results of these calculations for single-track bridges of various spans. From the shortest bridges up to 300 feet span, the curves show the total estimated load, including impact allowance, as a load which will give the same bending moment when uniformly distributed. The lower broken line on each diagram shows the purely static effect of a 20-unit loading. In the upper diagram the highest line of all is an enveloping curve which includes the largest impact effects that may be experienced under all three systems of loading, A, B, and C. Enveloping curves are required because we have to deal with bridges having various characteristics in respect of weight and rigidity. The full black line in an intermediate position is an enveloping curve which includes the greatest impact effects that would be experienced under

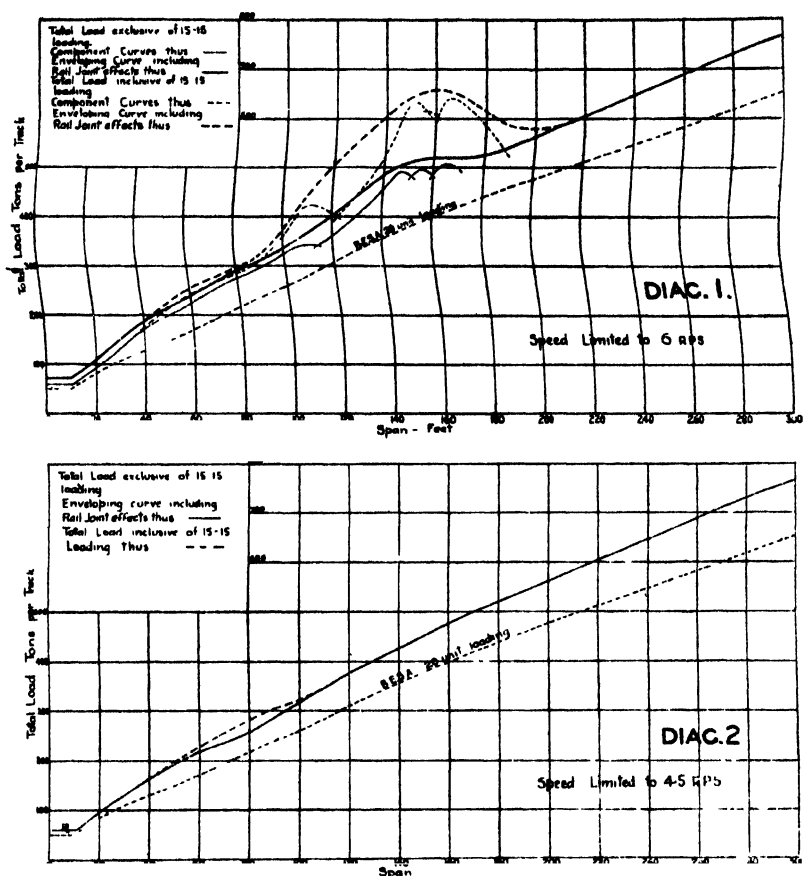


FIG 15—Estimated Live Loads plus Impact allowances in Single Track Bridges expressed as a uniformly distributed load

loadings A and B, but without loading C. Note the remarkable difference between these two curves in the range of spans from 100 to 200 feet. It is in that range, as I have already said, that the worst effects of impact may be experienced in consequence of resonance. Within that range there is a very conspicuous advantage in escaping the heavy hammer-blow that is provided for in the C loading. The lower of the two diagrams in Fig. 15 illustrates how much the impact effects are reduced when, instead of providing for the express speed of 6 r.p.s., we provide only for a moderate speed of $4\frac{1}{2}$ r.p.s.—a limit quite high enough to cover the case of many branch lines.

The tabulated numbers which are given in the Report for the use of engineers

are offered simply as a statement that according to our methods of calculation these are the allowances that should be provided if you have engines to deal with which possess the stated characteristics. We further set forth the methods of working out such results, so that for other railways not subject to the British limitations of gauge and loading gauge, engineers will, we hope, be able to apply the same methods to their own problems.

Perhaps I should add a word about shear. I have been speaking hitherto of the bending stresses, but we also investigated the effects of impact on the members which bear the shear, using for that purpose a group of extensometers attached to the web members. When the strains are measured in the vertical and diagonal members of a bridge, it is found that the greatest effects of impact occur at places about midway between the middle and the ends. It is there that the greatest shearing effects of impact are to be found, and theory shows that is where they are to be expected. Compared with the bending effects of impact they are not very important, but you will find tabulated values for them too in the Report.

In conclusion I would only say this: do not expect too much from the Report. Do not expect to find in it any simple rules—the subject is too complex to make simple rules applicable. But I think it may claim to have rationalised the treatment of a very difficult problem. It supplies engineers with numerical results that are appropriate in ordinary cases; and, what is of more consequence, it gives them a general method of calculation which, with a little trouble, should serve in cases which lie outside of the usual range.

THE CHAIRMAN, in moving a hearty vote of thanks to the lecturer for his address, said he saw present nearly all the members of the Bridge Stress Committee, and he was sure they would agree with him when he said that after listening to the lecture they had not only been intensely interested but their minds had been clarified on a subject about which they were supposed to know something. To those, also, who had not lived with the subject for several years he was sure the lecture had proved of the greatest interest. It was no small feat to have concentrated into an hour and ten minutes the results of a work which bulked so large, and he thought there were few people who could have come through that ordeal with flying colours as Sir Alfred Ewing had done.

SIR HENRY MIERS, F.R.S., in seconding the vote of thanks, desired to add his testimony to the extraordinary skill, grace and clarity with which the lecturer had dealt with and explained so difficult a subject. It was a subject about which he could express no opinion personally, but he knew what an amount of work it had involved. For many years past he had had opportunities for watching the academic work of Sir Alfred, and it had been a wonder to him how, in the midst of his other interesting work which was involved in the carrying on of a great University, Sir Alfred had found time and energy to keep alive his interest in scientific work. From the newspapers the regrettable fact appeared that Sir Alfred intended shortly to give up his academic work. It could only be hoped that that would enable him to give more time to his scientific work, of which he had given so striking an example in the lecture that night.

The vote of thanks was carried unanimously.

THE LECTURER, in acknowledging the vote, said it was true that he had announced his intention of giving up his position as Principal of the University of Edinburgh. Such work was engrossing and immensely interesting, but it made any devotion to railway bridges and locomotives, and things of that kind, a little difficult. He hoped that he might, in the future, have a little time for old scientific interests which, to a great extent, had been put on one side for many years.

The meeting then terminated.

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

MONDAY, MAY 6. Chemical Industry, Society of, at Burlington House, W. 8 p.m. Dr. T. Moran, "Recent Advances in the Low Temperature Preservation of Foodstuffs."

Farmers' Club, at the Whitehall Rooms, Hotel Metropole, S.W. 4 p.m. Prof. T. B. Woods, "Home-Grown Feeding Stuffs."

Geographical Society, at Lowther Lodge, Kensington Gore, S.W. 5 p.m. Dr. G. C. Smirson, "The Importance of Climatic Stations in Polar Regions."

Royal Institution, 21, Albemarle Street, W. 5 p.m. General Meeting.

Surveyors' Institution, 12, Great George Street, S.W. 8 p.m. Messrs. H. F. Bidder and W. V. Graham, "Rights in Underground Water."

Victoria Institute, at the Central Hotel, Westminster, S.W. 4.30 p.m. The Rev. Canon A. Lukyn Williams, D.D., "Early Anti-Judaism—the Book of Testimonies."

University of London, at King's College, Strand, W.C. 5.30 p.m. Prof. Pedro Salinas, "Thirty Years of Spanish Literature (1898-1929)." (Lecture III.)

At the London School of Economics, Houghton Street, W.C. 5 p.m. Prof. Henri Hauser, "The History of Banking in its relations with Economic and Political History during the Modern Era (XV-XVIII centuries)." (Lecture I.)

5.30 p.m. "Some Modern Philosophies of History." (Lecture II.) Rev. Dr. W. R. Matthews, "Proce."

At University College, Gower Street, W.C. 5.30 p.m. Air Vice-Marshal J. R. Scarlett, "The Air Defence Exercises of 1928, with special reference to the Air Defence of London."

TUESDAY, MAY 7. Hellenic Studies, Society for the Promotion of, at Burlington House, W. 5 p.m. Mr. A. D. Nock, "Greek Magical Papyri."

Marine Engineers, Institute of, 85-88, The Minories, E. 6.30 p.m. Ir. W. J. Muller, "Notes on the Lentz Standard Marine Engine as fitted to Ships of the Koninklijke Paketvaart Maatschappij (Royal Packet Line), Amsterdam."

Mechanical Engineers, Institute of, at the Institution of Mechanical Engineers, Storey's Gate, S.W. 8 p.m. Sir Oliver Lodge, "Some Ideas about Metals." (Annual May Lecture.)

University of London, at King's College, Strand, W.C. 5.30 p.m. Sir Bernard Parey, "Contemporary Russia." (Lecture II.)

At the Royal School of Mines, South Kensington, S.W. 5.30 p.m. Prof. E. de Margerie, "Some Aspects of French Tectonics." (Lecture I.)

At University College, Gower Street, W.C. 5.30 p.m. Prof. H. T. Baker, "Geometry—a Brief Review." (Lecture II.)

WEDNESDAY, MAY 8. Fuel, Institute of, at Burlington House, W. 6 p.m. Dr. S. Wolf, "The Scope of the Chemical Engineer with special reference to the Boilerhouse and the Fuel Industries." (Joint Meeting with Institution of Chemical Engineers.)

Geological Society, Burlington House, W. 5.30 p.m. University of London, at the London School of Economics, Houghton Street, W.C. 5 p.m. Dr. Hubert Hall, "The Nature, Value and Uses of English Judicial Records as Sources of Economic and Social Information." (Lecture II.)

THURSDAY, MAY 9. Aeronautical Society, at the Royal Society of Arts, Adelphi, W.C. 6.30 p.m. Captain F. Tyzans, "Civil Aviation Prospects in East Africa."

Antiquaries Society, Burlington House, W. 8.30 p.m. Electrical Engineers, Institution of, Savoy Place, W.C. 6 p.m. Annual General Meeting.

Historical Society, 22, Russell Square, W.C. 5 p.m. Miss Rose Graham, "Administration of the Diocese of Ely by Archbishop Winchelsea during the vacancies of the See in 1298 and 1302."

Iron and Steel Institute, at the Royal Technical College, Glasgow. 7 p.m. (1) The Hon. Sir Charles Parsons and Mr. H. M. Duncan, "A New Method for the Production of Sound Steel"; (2) Committee's Third Report on Heterogeneity of Steel Ingot; (3) Committee's First Report on Blast-Furnace Plant and Practice; (4) Mr. L. H. Lewis, "Twenty Months Results of Dry-Blast Operation"; (5) Mr. W. E. Simons, "The A.I.B. Sinter Plant of Messrs. Guest, Keen and Nettlefolds, Ltd., Cardiff Works."

Oil and Colour Chemists' Association, at 30, Russell Square, W.C. 7.30 p.m. Mr. F. Fancutt, "Painting as it affects the Railways."

Optical Society, at the Imperial College of Science and Technology, South Kensington, S.W. 7.30 p.m.

University of London, at King's College, Strand, W.C. 5.30 p.m. Prof. Pedro Salinas, "Thirty Years of Spanish Literature (1898-1929)." (Lecture IV.)

5.30 p.m. Dr. Stanley A. Cook, "The Religion of the Old Testament in its Historical Setting." (Lecture II.)

5.30 p.m. Mr. Ifor L. Evans, "Agrarian Reform in the Danubian Countries." (Lecture II.)

(King's College), at 40, Torrington Square, W.C. 5.30 p.m. Dr. Julian Krzyzanowski, "Sir Walter Scott and the Origins of the Historical Romance in Poland." (Lecture II.)

At the London School of Economics, Houghton Street, W.C. 5 p.m. Prof. Henri Hauser, "The History of Banking in its relations with Economic and Political History during the Modern Era (XV-XVIII centuries)." (Lecture II.)

At St. Thomas's Hospital, Albert Embankment, S.E. 5 p.m. Prof. S. J. Cowell, "Dietetics." (Lecture II.)

At University College, Gower Street, W.C. 5.30 p.m. Prof. I. Petersen, "Faust" (in German). (Lecture II.)

FRIDAY, MAY 10. Astronomical Society, Burlington House, W. 5 p.m.

Chemical Industry, Society of (Chemical Engineering Group), at the Criterion Restaurant, 221, Piccadilly, W. 6 p.m. Annual General Meeting.

Malacological Society, at University College, Gower Street, W.C. 6 p.m.

Mechanical Engineers, Institution of, Storey's Gate, S.W. 6 p.m. Special General Meeting.

Physical Society, at the Imperial College of Science, South Kensington, S.W. 5 p.m. Mr. W. S. Sumner, "Heaviside's Fractional Differentiation."

2. Mr. J. H. Aulbury, "A Simple Method of Fitting a Straight Line to a Series of Observations." 3. Mr. E. W. M. Selwyn, "Arc Spectra in the Region $\lambda 1600$ to $\lambda 2000$." 4. Dr. K. R. Rao, "The Spectrum of Trieblichised Thallium." 5. Mr. G. A. Wedgwood, "The Elastic Properties of Thick Cylindrical Shells under Internal Pressure." 6. Mr. J. E. Sears, "A Demonstration relating to Standards of Length and Mass."

Transport, Institute of, at the Midland Hotel, Manchester. 6 p.m. Annual General Meeting.

Royal Institution, 21, Albemarle Street, W. 9 p.m. Prof. Dr. E. Boycott, "The Twist of Snail Shells."

University of London, at King's College, Strand, W.C. 5.30 p.m. Prof. Henri Hauser, "The Modernity of the Sixteenth Century" (in French). (Lecture I.)

5.30 p.m. Prof. A. Mawer, "Problems of Place-Name Study in the Light of Five Years' Work of the English Place-Name Survey." (Lecture II.)

At the Royal School of Mines, South Kensington, S.W. 5.30 p.m. Prof. E. de Margerie, "Some Aspects of French Tectonics." (Lecture II.)

At University College, Gower Street, W.C. 4 p.m. Prof. Dr. A. J. Hall, "Some of the Sequels of Epidemic Encephalitis (Lethargia)." (Lecture II.)

5.30 p.m. Lektor Rolf Fander, "Norwegian Ballads." (Lecture I.)

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 3990.

VOL. LXXVII.

FRIDAY, MAY 10th, 1929.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C (2)

NOTICES.

NEXT WEEK.

MONDAY, MAY 13th, at 8 p.m. (Aldred Lecture.) SIR E. DENISON ROSS, C.I.E., Ph.D., Professor of Persian and Director of the School of Oriental Studies, University of London, "Nomadic Movements in Asia." (Lecture IV.)

WEDNESDAY, MAY 15th, at 8 p.m. (Ordinary Meeting.) ROBERT BURRELL, Barrister-at-Law, "The Reforming of the British Patent System." JAMES SWINBURNE, F.R.S., Past-President of the Institution of Electrical Engineers, will preside.

TWENTIETH ORDINARY MEETING.

WEDNESDAY, MAY 1st, 1929. THE RIGHT HON. LORD ASKWITH, K.C.B., K.C., D.C.L., in the Chair.

A paper on "Building Models" was read by MR. P. MORLEY HORDER, F.S.A. The paper and discussion will be published in the *Journal* dated July 12th.

ALDRED LECTURES.

MONDAY, MAY 6th, 1929. SIR E. DENISON ROSS, C.I.E., Ph.D., Professor of Persian and Director of the School of Oriental Studies, University of London, delivered the third of his course of four lectures on "Nomadic Movements in Asia." The lectures will be published in the *Journal* during the summer recess.

PROCEEDINGS OF THE SOCIETY.

FOURTEENTH ORDINARY MEETING.

WEDNESDAY, MARCH 6TH, 1929.

MR. PERCY V. BRADSHAW, in the Chair.

THE CHAIRMAN, in introducing the lecturer, said he noticed that the Royal Society of Arts had been founded in 1754 for the encouragement of Arts, Manufactures, and Commerce—in short, for the encouragement of Mr. Tom Purvis. He doubted whether the members of the Society had ever been addressed by a man more completely associated with those three interests than the lecturer.

He felt that it was hardly necessary for him to introduce Mr. Purvis to the audience, as they had met him on many previous occasions. He had greeted them in the carriages and lifts of the Underground Railways; he had spoken to them from the hoardings, the bookstalls and many other places. He had, in his admirable Austin Reed advertising, shown discerning men what a gentleman really looked like—and what a person had to do to become one. He had, in his posters on the hoardings, sent people scuttling off to buy every kind of commodity, from a copy of *John Bull*, or a tin of desiccated soup, to a North Eastern Railway ticket. He had, in most of his designs, introduced more salesmanship than a Chairman of Directors usually achieved in the lengthiest speech, and he had reminded the man of commerce very forcibly that the artist was a most important factor in modern business. In fact, Mr. Purvis was a kind of pictorial Pooh-Bah—Arts, Manufactures and Commerce rolled into one.

Personally, he had had a life-long experience of artists—especially of illustrators and designers—and it had always been his contention that the real artists, as apart from the crank and poser, was an extraordinary logical, analytical and level-headed person, and that his originality and inventiveness would be invaluable in the solving of most business problems.

In the past only a limited side of the artist's equipment had been used. He had been regarded simply as a painter or draughtsman, and he had only been called in by commerce when a cut and dried idea had been decided upon, and a drawing was wanted. His talent should be used earlier, and much more completely. He should be consulted, not dictated to. He could be just as important and valuable as any other professional specialist, and Tom Purvis was very typical of the artist who knew his job, and did it with astounding success.

Personally he believed, as the Royal Society of Arts believed over 170 years ago, that a closer relationship between Arts, Manufactures and Commerce was vitally important. He was convinced that the hundred millions a year which were being spent on advertising British goods, could be spent much more effectively, and that advertising was not appealing as fully as it should to educated, intelligent people.

A lot of advertising was artful rather than artistic—designing rather than designed. The fine artist need not be a "mere visionary." In fact, he must not be, if he was to live. He could not resist quoting the words of a very distinguished artist, Edmund J. Sullivan, spoken in an address to students, to the effect that commerce was now taking, as Art patron, the place formerly occupied by the Church, and that there was no reason why Commercial Art to-day should degenerate into pot-boiling.

"It is not," said Sullivan, "the subject that matters, nor the patron who commissioned it. Sincerity is the thing that counts. It is not difficult, once the

fancy comes into one's head, to imagine the hoardings covered by posters, and the advertisement pages of our magazines filled with drawings, by Dürer, Holbein or Rembrandt. What detraction would there be from their Art? What subtraction or dignity from them and their greatness? What more can any of that great trinity have wanted by way of subject than to draw an advertisement for soap, an appeal for charity, or a portrait of the inventor of a patent medicine? Is not one of Dürer's most moving drawings simply a pair of hands? Let him draw for Lever Bros. Have not inventors of patent medicines faces? Send their photograph to Holbein. Is not a beggar as moving a subject as a haloed angel? Ring up Rembrandt. Well, then, don't let us go talking about High Art in any hoity-toity spirit. Let it be seen to that Commercial Art is not like the famous razors, only meant to sell and not to cut. If it is Art, it will be Art. If it is commercial first, it may not be Art afterwards, any more than a religious picture is necessarily high Art. Precision, definition, clear statement, lucidity—these are the stuff of imagination in action."

Personally he did not know any more convincing proof of imagination in action than his friend, Tom Purvis, could provide.

The following paper was then read:—

COMMERCIAL ART.

By TOM PURVIS.

I approach my task with a great deal of perplexity, because the more thought I devote to it the more the realisation comes to me that the subject is far too vast for a short paper such as I am giving to-night.

Commercial art—that is, advertising art—is one of the great inter-related sections of the immense and growing profession of advertising, which itself is a logical development of the spread of commercial enterprise in the last fifty years. Commercial art itself has so many facets and ramifications that it is impossible to touch upon any but just a few main sides.

My intention is to speak on commercial art to you from the artist's point of view, and to endeavour to show you that, as a field for artists, it is not to be despised any longer, and as an adjunct to advertising enterprise it is a factor of growing importance and of vast possibilities. It seems to me that commercial art is the legitimate successor to the entirely different but equally commercial art of the Middle Ages, where artists were employed to paint pictures and decorations for the great churches—one *could* say for the purposes of religious propaganda. Then again, they were employed by the great nobles on works of art; one *could* say, here, for *personal* propaganda.

The purely æsthetic and educational value of Art will always inspire the man who feels that it is his mission to remind the world of beauty. If one forgot that Art has its place in the world—that it ranks as an ennobling influence with music and poetry, one would have to turn the faces of Old Masters to the wall and close the World's Picture Galleries.

I do not forget the claims of Art for Art's sake, or the work of the fortunate few who are able to live by painting pictures. My belief is that Art has an even greater purpose than the merely cultural and inspirational and a more definite and vital relationship with life and progress.

I claim that Art to-day is being applied, and should be applied more definitely to human needs, and it is the type of Art which helps to develop the Nation's prosperity that I want to discuss with you.

Art for Art's sake has, I am afraid, come to be regarded more and more as a delightful luxury in this very practical age. The artist is expected to do something in addition to looking picturesque and dreaming dreams. Fewer and fewer artists are able to live by painting pictures for the drawing room wall. The World becomes increasingly impatient of theorising by "Arty Folk" and by affected studio jargon.

Art for Art's sake is an increasingly difficult text on which to preach a convincing sermon, and I feel that we commercial artists who give of our best are not only helping a very wide public to appreciate the beautiful, but we are also helping to develop an appreciation of fine design and craftsmanship.

I wish I could use Frank Brangwyn's language on the subject when it happened to be broached one day when I was on a visit to him. His words were to this purpose :

"Art must have definite usefulness in life. It is not a matter of -isms or theories. It is solid craftsmanship mixed with brains, and to survive must serve some definite purpose ; that is, be *applied* to that purpose whether it be decorating a building or designing a spoon. The great day of the easel picture is waning, and art *must* be useful again as well as decorative. There is a lot too much talked and written about it and too little done ; and it is only what is *done* that counts."

In his own work Frank Brangwyn looks upon himself as "a superior decorator," and I humbly but entirely agree with him on his outlook. It seems to me, apart from anything else, to be so much more healthy a point of view. No one could possibly look upon Brangwyn's work as being unhealthy in the slightest degree ; although once, at an exhibition, I overheard two ladies discussing a marvellous Brangwyn decorative picture (a riot of wonderful colour), and one of them criticised it as being "so dreadfully untidy." If they had only stood back from it another twenty yards, the "untidiness" would have vanished. Brangwyn rightly does not care to exhibit his pictures in galleries. As he says, they are done for a special purpose or environment, and, outside of those surroundings, cannot be expected to give their best.

I have been constrained to mention the man I consider the greatest living artist, because he is the greatest living commercial artist and is proud of it.

Commercial art is the future field for artists, as it has been in the past, whether the artist devote himself to commercial advertising or to furniture designing or mural decoration.

Long hair and a sloppy reputation do not make an artist. It is his work that counts, and the best measure of the value of his work is its purpose in the world.

From this generalisation I am now going to particularise and speak of commercial art solely as applied to commercial advertising needs.

First and foremost let me start by asking you if you realise how an artist gets his experience and his knowledge for the application of his ability and special training to commercial purposes. Here forgive me if I explain exactly what I mean by commercial art. It is treated widely as a generic term capable of including any pictorial crime committed in the cause of commerce, particularly on the hoardings. Seriously, commercial art is the ability of the artist applied to the purposes of commerce; that is, like furniture designing or wallpaper designing, it is an *applied* art—art applied to commercial needs. A good commercial artist must be as much a salesman as an artist. At times more of a salesman than an artist. Sad as it may seem to artists, he must *never* let his salesmanship be obliterated by his artistic sensibilities. He must have a very clear understanding of salesmanship. The final purpose of his work being to attract his audience with his message in such a way as to leave them interested in, if not actually convinced of, its entire desirability to themselves, his aim must be sure and his judgment unerring, conveying his own complete conviction of the value of his client's commodity. Advertisement designing demands imagination, invention, craftsmanship, and salesmanship.

A halo has grown round art and artists, and it is the commercial artist who has the opportunity of showing the business man that art is after all just common sense and is perfectly capable of dealing with pictorial *business* problems equally as well as, or instead of, the moral indiscretions of mythological deities or the classical features of the Mayor of Slushcombe.

The great value of art applied to commerce is being more and more widely appreciated by business men, and to my mind they are getting more keenly critical of it every day.

I think it is a dire fault that there is no completely equipped school in this country exclusively devoted to the training of students in the technique of art as applied to advertising needs, *captained* by men of actual experience and backed by business men. In many schools the commercial art classes are treated as unwanted pups. One of these days I am sure we will have schools equipped and run specially for the student of advertising art. Training at these schools would only follow after a proper orthodox art school training such as the art student undergoes now. Most students think that when they leave the art school they are finished artists—even finished *commercial* artists! As a matter of fact, they have only been put in possession of their tools. The application of these tools would be the object of the school of commercial art that I am waiting for.

My Chairman to-night recognised, over twenty years ago, the necessity for tuition in Professional Illustration, and the Press Art School, which he established, has had a big influence on improving the standard of modern illustration.

It is to Mr. Bradshaw's very thorough and sincere Courses of Correspondence tuition that many of the most successful illustrators of to-day owe their introduction to professional careers. Well-known artists and editors have collaborated with him in the development of his work, because they realise its usefulness.

He has always been the friend of the commercial artist and illustrator. His folios of "The Art of the Illustrator" and his book "Art in Advertising" are recognised as the standard works on the subject, and he has written innumerable articles for the magazines of this country and America to help the public appreciate the best types of illustration. But one man, even if his pupils *are* distributed all over the world, can't accomplish all the work that is to be done in training the art student, and that's why I think that a very completely organised School of Commercial Art is needed.

I know there are many official schools endeavouring to help the student, to name only such well-known ones as the L.C.C. School of Printing, the Central School of Arts and Crafts, and the L.C.C. School of Engraving at Bolt Court. There must be many more, but the immense development of commercial needs in recent years, to my mind, demands some form of tuition even more allied to the needs of commercial art students. I may be wrong, but I have never heard of a school where a complete advertising campaign with all its policy and purpose is explained or in which the student is impressed with the wider aspects of the advertising man's job.

For want of such help it cost me over six years to learn something of the application of art to advertising from the inside of an advertising agency. Incidentally, my chief was one of the most enthusiastic nigger-drivers I have ever met. His enthusiasm included himself as one of the driven niggers. He was the hardest worker of the lot of us, and a brilliant advertising genius. When I felt I knew more than he did, I left—and got a shock. I found also that in my special desire to be a poster designer, I knew nothing about the practical side of lithographic printing. Back I went to a printer's, this time for roughly, two years. I believe I could design, lithograph, mix the inks necessary, do the printing and plaster the hoardings with a poster, if someone will pay the perfectly enormous fee I should ask for this unique effort. The serious side is that eight years or so were spent learning something of my business after successive art masters had washed their kindly hands of me. That is the school of commercial art I graduated from, and I should like to see some quicker and less energy-wasting method of training for students of advertising art.

Lately, I had the pleasure of reading a paper to the Publicity Club of

Bradford, and saw at the Bradford School of Art and Crafts something of the idea I have in mind being carried out under the able and energetic direction of an old art master of mine, Mr. W. H. Meggs, who very kindly showed me over the whole school during working hours. Here I really saw a splendid effort at applying art in a commonsense way to commercial needs, and it seems to me to be an exception which proves my point. Mr. Meggs' energy is greatly to be commended. His school equipment on the process reproduction side alone would make some engraving firms "sit up." It seems to me that art may have a new meaning and dignity amongst the hard-headed business men of Bradford, which is all to the great benefit of both artists and business men. One firm had commissioned the school students to repaint and decorate their motor-van, and the manager was so excited about it that he brought it round to my hotel specially to show me. It was receiving great attention wherever it happened to be, and rightly so. It was a very tasteful effort and would be bound to reflect on his business, which was the manufacture of high quality leather goods. I do think that this more intimate co-operation of business men with the art schools is an excellent step in the right direction.

I do not think that any form of publicity has the glamour surrounding it that posters have got. Princes discuss posters at banquets and even Royal Academicians now do them in their spare moments. More books have been written on the subject than on certainly any other form of advertising. Why is this? Is it that the "Poor Man's Gallery" is not his at all? Is it becoming a debating-ground of the Highbrows, or is it so universally interesting a form of appeal that even advertisement-proof highbrow demigods are attracted by it and to it? To my mind it is simply the appeal of the picture to the fundamental human. The first means of communication was by signs illustrating simple needs—food, shelter, defence, and so on—and the illustration has remained as being the most fundamentally interesting and the quickest means of conveying ideas.

One of the purest forms illustrating this point (I call it the Ancestor of the modern Poster) is the science of heraldry. A man or tribe was known by its own mark illustrated on its possessions. The designs of most early coats of arms are an epitome of the history of the family owning them. Some are marvellously good designs. The simplification of forms used is specially good poster form and treatment, telling its story with maximum visibility and minimum detail. I feel that a thorough study of heraldry would be useful to anyone wishing to buy posters. Some of the heraldic devices would make most admirable posters. Even the laws of colour as understood in heraldry are true colour-relation for poster visibility. I am not alone in this idea. I have heard my friend, Sir Lawrence Weaver, expound on exactly the same subject at some length and much more ably than I could possibly do it.

This mention of heraldry brings me to what to my mind is the most valuable

asset of a well-designed poster ; its shock value. By shock value I mean its kick, strength, visibility, immediate readability. In this lies the poster's greatest value to the advertiser. It is the spear-head of the charge, or the shock troops of the campaign ; but how many firms really show understanding of this in their choice of design. The shock value is where your artist, if he knows his job, should be left alone. Give him the indispensable elements and then leave him alone.

Which point do you want emphasizing ? And here let me say that a poster, to be a real winner and give its full service, must say one thing absolutely clearly and emphatically. When you have your elements fixed, I repeat, leave your designer free to do his best. It is *his* job to analyse the material and arrange it. The measure of his skill will be the deliberate unusualness of his arrangement, based on his specialist knowledge. The freshness and shock value of the poster depend on this and this alone, even if you *are* announcing free motor cars with a pound of tea.

The artist's training in colour values alone is a very important asset to the advertiser, and the more I see of colour (and I see a lot of it), the more I realise what an enormous power it has over everything in our lives.

I once met a man who was very keen to demonstrate that it was possible so to design a succession of colour arrangements that a victim entering at one end of a series of specially decorated rooms would need a padded room in one colour only at the other end. This, in theory, sounded interesting, and I asked him to just let me peep at the design of No. 1 room of his colour arrangement. I firmly believe I should have needed the one-colour room as No. 2 arrangement if I had looked long enough.

Colour is a remarkable thing, and yet colour is just a relative term. One tone so depends on its neighbours for its beauty and life, that colour is *not* colour ; it is only a bad pink or cheap-looking blue, or just green paint, until it is qualified by juxtaposition with another. Then, immediately, the inter-relation of one colour to the other makes a definite difference to the value of both, and design steps in. The possibilities of this wonderful force in the advertising profession is hardly realised yet ; but it really needs a specialist to deal with it—even a specialist artist. Many very fine artists have no great mental reaction to colour as an orchestrated whole. It is a side of design which needs as much vision and composing as a musical symphony, and in your poster comes once again the enormous value of the unusual in its *colour* arrangement. But this is a subject much too great for the time at our disposal.

I would just like to add : Give your artist his head and, excepting in cases necessitating rigid economy, let him have that extra printing which he prays for sometimes and so seldom gets. Most poster artists knowing their job can even economise for their clients, help the printer at the same time, and still get the effect they want in their work.

A very valuable point in poster design is flatness of the masses of colour.

giving maximum effect, visibility and additional value to your colour by not clogging it up with dirty grey or brown half-tones and shadows

I think that a good poster should start from the surface of the hoarding outwards and not recede into the hoarding as though the spectator was looking through a window. The surface should still look solid as if anything hitting it would bounce off instead of going through a hole. Perhaps it will explain my point better if I say there must be no hole in the hoarding caused by your poster. The finest examples of flatness and the feeling of impact are those of the Beggarstaff Brothers.

Stalwarts like the Beggarstaff Brothers opened the ball for the improvement of posters, and in their days opened the eyes of astute business men to the value of the space they bought on the hoardings. Since then, the way has been paved, and it is for their followers to improve, if possible.

Just think of the Beggarstuffs. Although the number of their posters was not large, their extraordinary insight into the possibilities of the poster, and their truly remarkable grasp of its first principles, were so astounding that they can be called the progenitors of all *modern* poster designs. Their ideas were flouted here by the timid, and they gave up the business, disappointed men. It was left to Germany to show us they were right. And some of us now look with awe on the Continental productions, not realising that the great principles of poster design were solved the first time by two of the most British men in Britain—two of our finest artists still—James Pryde, whom I am proud to know personally, and William Nicholson—who, together collaborating under the nom de plume of “The Beggarstuffs,” showed business men and artists the possibilities of poster design. Germany, quick to pick up ideas and develop them for her own ends, grasped the Beggarstuffs’ idea of the poster, and some very fine results have been achieved there. Germany has, as I say, some very fine poster designers; but I do not see why it is necessary for our artists to bow down and worship the results as much as they seem to do. The Beggarstaff principles have proved themselves right, and now both business and art in England are recognising the value to commerce of the simple, clear, and emphatic poster. Men like Mr. W. M. Teasdale, of the L.N.E.R. (one of the most appreciative and sympathetic men it has been any artist’s pleasure to work for), and my very good friend Mr. Austin Reed (I am often asked if there is *really* an “Austin Reed” There *is*; and a more genial and broad-minded man I have still to meet) these men stand out to me as shining examples of artists in commerce. There are plenty of others. Many business men I know bring more art into their commerce than some art students bring into their *art*. To my mind, these men are forerunners of a new type of business man—business men who are artists.

Many artists think, being able to draw, that they have reached the end and can sit tight for millionaires to roll up. Many commercial artists are

hoping for the day when they can cut clear from the "indignity" of commercial art and attain fame by painting a masterpiece and be courted by collectors. To my mind, this is complete fallacy. No artist who holds his best back for a future possibility is likely to hold his own. The problem of working within definite limitations is his test as an artist.

William Nicholson and James Pryde have not suffered in their subsequent work from putting all their energy into their work for the printer. Another man (in France), whose early sphere of work was the poster, is Grün. In Paris, at the Salon, a couple of years ago, I saw a most delightfully designed and painted picture, and to my astonishment it was signed "Grün," showing that he (as, I believe, also the Beggarstafis) actually benefited in painting from experience in the poster world. Mucha was not ashamed to design posters while he also was busy on large mural decorations. Our own Frank Brangwyn delights in working to the limitations of the poster, and did so long before he was world-famous. He still keeps his eye on the hoardings, and is quite up-to-date with its happenings.

An artist's greatest asset is elasticity of mind; and to me there is nothing like the exercise of designing a poster for a given purpose, with given limitations, and to be printed in a set economical way, for developing elasticity of mind. It is the problem that counts; and when an artist gives up trying to solve problems, it is time for him to give up being an artist.

I do not wish you to feel that I have too great a bias on what are commonly known as art posters—those posters whose lucky job it is to express the desirability of holidays—designed mostly with joy by the artist, and looked at, perhaps, with a certain amount of disbelief, sometimes, by a public only too well aware of the existence of the English climate. I mean my remarks to be equally applied to toffee posters and baking-powder posters—all those commodities with apparently no great artistic possibility. They can all be treated with the magic of design and colour, to their good and their proprietor's profit.

One of the greatest factors militating against fine design in all branches of advertising art is the too individual personal interest of the various parties concerned. Everyone thinks he is a useful critic when it comes to the art side of a campaign. Especially is this so with posters.

Personal likes and dislikes and idiosyncrasies must be held in check. The man engaged as the specialist should, of course, be expert enough and have licence enough to use or discard any points he may think harmful to the general idea or quality of the work. I did a poster once for a firm, in which orange was the dominating note, and orange was a happy colour for the particular commodity, expressing a feeling of optimism which suited it well. The Board of Directors got to work on it, and the first devastating criticism I got was from one man, who said: "Personally, I dislike orange intensely, and hope we can get some other colour to take its place." They finally took

the poster with the orange. Someone might think this an example of "salesmanship"!

I always think that "too much handling spoils the poster." The only result of pleasing everyone—or rather, trying to meet everyone's criticisms, is that, in the end, the work will be so completely innocuous that no one will take notice of it at all. If it does not actually offend, it still will never arouse enthusiasm or pleasure. A bold stroke will attract attention even if it does not please everybody. And what commodity advertised is so completely universal that it will *itself* appeal to everybody?

It should be the object of the artist to utilise every atom of his ability to aim at, and hit, the precise objective of the advertiser, irrespective of even his own personal idiosyncrasies. As I have said before, commercial art is applied art.

The general trend in quality of design is very definitely upward. My experience is that there has been a steady improvement in imaginative and technical accomplishment and appreciation the whole way along. Haphazard methods of filling valuable space, and personal idiosyncrasies in selection of drawings or ideas, are slowly giving place to a well-ordered, knowledgeable selection, with a full realisation that the best space requires economical using. By economical using I do not mean the cutting down of prices and thereby cutting down quality. I mean the filling of space with idea or argument carefully calculated to convey its message efficiently without waste. Naturally, the reward of skilful work is, and should be, greater than the cost of mere haphazard methods. The economy comes in the result achieved—the "bacon that is brought home," so to speak. The expense of the haphazard method is in its failure.

The public is becoming more severely critical than many, I might say most, firms contemplating their own advertising fully realise; and I am sure I shall be supported by men of experience on this point. The best is none too good a setting for a fine jewel. A fine jewel in a poor setting suffers badly. A poor jewel in a fine setting has a much better chance of attracting. Advertising art is what one might call the public "setting" of the particular commodity, and if this "setting" is poor, haphazard, or slipshod, it instantly decreases the apparent value of the jewel.

I do not want you to think me biased on the side of posters. Newspaper advertising is so much a matter of team-work, and I consider an artist's position just that of a member of the team, equally important as your layout man, copywriter and typographer, but no more—just one of a team of experts working as a team should—each for all. The creative side of this team work is divided up between all the team, and for one to claim credit above another is as wrong as for a footballer kicking a goal thinking that his was the strategy that led to the position enabling him to kick the goal. The artist's job here is to carry out instructions, and if he thinks of an improvement, suggest it, and if it be not adopted—stay in the team.

To my mind the art of the newspaper advertising illustration has made an enormous improvement since the war. Signs of it were visible before 1914. but, looking backward, I think the real jump has come about since 1918; Possibly increased taxation has forced the necessity for the broader economy; possibly more severe competition. Possibly the hardier spirits, gifted with broader outlook, having blazed the trail and made it easy, others, now seeing profit in what they themselves first believed to be extravagance or rashness, have followed; possibly all three reasons together. Whatever the reason, the improvement is most noticeable.

In posters reason is perhaps easier to find. The poster branch of advertising is peculiarly a field of expression for artists—not that I think they do not need co-operation with other experts in the advertising profession. I have already pointed out that they do. What I mean by peculiarly the field of expression of artists is this: The artist is specially expert in pictorial representation within his own limitations of mind. His training of brain, eye and hand suits admirably the field of poster design where the spectator's attention has to be rivetted and the appeal is to be complete at a glance. Easel pictures are not easy to sell nowadays, and as the field of advertising widens it is attracting more and more talented artists who realise the enormous possibilities of poster design as a serious outlet for their efforts and as a livelihood. This all makes for improvement in quality.

Lots of advertising people still smile a little when modern art is mentioned, I do, at some of it. But I do think we have to thank the hardy spirits who opened up the lost or forgotten possibilities of the value of simplification of form in the expression of an idea and the tremendous value of rhythmic and ordered pattern in impressing that idea on the mind. I will try and explain. The artist once studied composition with a purely photographic eye, and endeavoured further to convey a sense of reality by meticulous and scrupulous attention to what he understood to be nature and truth. His idea was to idealise nature but to stick to her through thick and thin, endeavouring to copy her to the last detail. But the infinity of nature and the infinity of her detail defeated him, and he resolved to give an impression of her translated through his skill into paint. This was possible, and we had the schools of impressionism. Still seeking for means of clearer expression of his ideas of nature, he found that elimination of inconsequent details gave more force to the essential points; and then he found the extraordinary value and force given by the elimination were increased by marshalling the points into control with a carefully ordered pattern or rhythm harmonising with his subject, and so attained to the modern view where basic design and structural arrangement are as essential to a picture as to a building.

One of the greatest uses of the modern movements in art to advertisers is in the filip^s it has given to freshness of outlook. The dramatic value of pattern has opened their eyes to an apparently new field in advertisement

design. Mind you, I'm not defending *all* modern art. Some of it is just mad striving for notoriety, and is always productive in me of the feeling engendered by my first glimpse of the design for No. 1 room in the colour arrangement for driving people mad. I am just expounding the serious development as I view it myself. An artist with any degree of brain activity cannot overlook any alley by which his work may profit, and I must say I have profited by a realisation of the modern outlook, and have applied it as capably as I could to my own problems in poster design.

The fundamental principles are applicable to every design, whether purely realistic in the popular art sense, or in the more concentrated symbolic realism in the modern art sense. The value of spacing and arrangement are just as important if the poster has a tin of salmon as its central ingredient. And here I say emphatically that a fine poster in a modern style *can* be made including a tin of salmon, and that it can still look appetising as a tin of salmon to a person who has never done anything but dodge anything looking remotely like modern art.

I think I can say that I am the first artist to get away with a poster including faces without any features on them. And the first one was this : (" Girls in Boat " poster for L.N.E.R.)

Some people believed me to be spoofing them. The effect I was aiming at was that of brilliant sunlight directed straight on to my group ; and, as you all know, sunlight, if it is so bright that it hurts your eyes to look at it when you come out of a shadowy room, leaves an impression on your mind of broad masses of colour without detail ; and in working out my pattern I found I had gradually and logically reduced everything to complete silhouettes in spots of colour and did not need features at all, excepting where they affected the shapes of masses.

I do not eliminate to save drawing. This poster was completely re-drawn and re-painted over half-a-dozen times. The process of elimination was gradual. Another point (and no one has ever pointed it out to me) is that the position of the boat would show the other oar clearly ; but after a lot of thought I decided to leave it out, and have been justified. In the Austin Reed posters, the point to be emphasised is clothes and their proper environment : just as much detail as is necessary to express that, and nothing more.

The Shell posters are exhibited on moving petrol and oil tank lorries, and have to convey their impression faster than the lorry on the move. Everything is eliminated that would tend to fog the instant realisation of that idea as far as I possibly could.

To sum up, I should like to say this : We hear lots of talk about artists not being business men ; but what I should feel grateful for, and I think commerce would benefit greatly by, would be more business men who were artists ; that is to say, let us have more artistic understanding in commerce and there will be much more commerce in art. There is great need for a closer co-operation between artist and business man in England.

DISCUSSION.

THE CHAIRMAN, in opening the discussion, said that if there was any business man who had grave doubts as to the sanity of artists, and who had considered them irrational beings, full of technique and temperament, he hoped that Mr. Purvis would give him something to think about.

An important fact that the lecturer had emphasised was that Commercial Art was applied Art—that it ought to be considered from that standpoint chiefly, and on account of its suitability to its purpose. It had not only to be attractive as Art. It must sell goods or service; and that needed qualities which were not expected of the purely æsthetic types of Art.

Mr. Purvis had also emphasised the vital importance of the Commercial Artist needing a very complete technical equipment—a knowledge of reproductive processes, printing, inks, papers and materials. This knowledge could only be acquired fully by such experience as he himself had had.

Mr. Purvis had also traced, in an interesting way, the ancestry of the poster, and the value of simplification. Not only from an economic point of view, but for the purpose of delivering a message in the most direct way, simplification was essential. But the business man in a hurry had to be reminded that simplification was not an excuse for an artist to dodge work, or for the business man to dodge payment.

It was just as difficult to achieve the effect of a full colour subject, with the simple use of three or four colours, as it would be for a musician to compose a symphony with three or four notes.

He was very glad that Mr. Purvis had referred to the great influence of the Beggarstaff Brothers, for it was a little pathetic to hear German artists lauded to the skies and to find their heavy influence affecting British advertising, when one knew that they had merely adopted the methods of two essentially English artists.

Then Mr. Purvis had touched upon his favourite topic, "The Relationship between the Artist and the Business Man."

Of course he had had to refer to the artist's stock complaint, the tendency of the business man to interfere. That complaint was fully justified. He never knew how a design got on to the hoardings or into the advertisement pages of periodicals when more often than not the work had had to emerge from the criticism of a Board of Directors.

Interference by non-technical people trying to show an expert how to do his job was largely responsible for some of the very bad work seen. Advertising must of necessity imply team work, a thorough consideration of the purpose of an advertising campaign, collaboration with sales managers, copywriters and other colleagues, and the artist was only one contributor to the final result; but he should surely be left to deliver the final message to the public in what experience taught him was the most effective way.

Mr. Purvis had, of course, referred to the very latest phases of Modernistic Art, in which the artist was trying to use symbols and patterns rather than the more familiar "representational" methods. Enterprise and experiment must be encouraged in advertising, but personally he did feel that agents and advertisers were losing their heads somewhat in their violent striving for "Novelty at any Cost." They were talking to the public in a language which the vast majority of the public could not understand. Many young artists were flying to the wildest experiments in modernism because it enabled them to dodge difficult drawing. It could not be done. Eccentricity in personal salesmanship was not yet popular. Freaks and contortionists were not yet engaged by level headed business men, so as to

arrest attention and secure sales for their goods. Therefore, he could not feel that the violent rejection of all traditional methods in pictorial salesmanship was justified.

Mr. Purvis's final remarks had struck right home to him—the great importance of business men knowing something about Art, as well as artists knowing as much as possible about business. Mr. Purvis had made an appeal for closer co-operation between Art and Commerce. That was a matter of tremendous importance. He had himself written 150,000 words on the subject a couple of years ago, trying to give the most convincing evidence he could as to the value of Art in advertising, and, fired by the meeting's obvious interest in Mr. Purvis's talk, he was going home to write some more.

MR. S. C. ROWLES thought it would be interesting to hear the views of the general public, as against the views of the artist himself, with regard to the relative attractiveness of posters. For instance, Mr. Purvis had exhibited on the wall two posters, to one of which he gave a distinct preference, but the other of which he (Mr. Rowles) ventured to say would appeal most to those persons whom it was meant to attract. A great deal had been said that night about the art side and the decoration side, the appeal of distance and of colour and so on, but it was an interesting fact that at the recent exhibition at Olympia the posters which had obtained the most votes had been the naturalistic posters.

MR. J. ASHBOURNE remarked that his own opinion of the Olympia Exhibition of posters was that the modernist poster had not been so well represented as had the naturalistic poster. Therefore he did not think that the ballot had been a fair test as to which of the two methods of poster advertising was the more effective.

The lecturer had referred to an ideal school of art. Personally he would like to see a school for advertisers, where advertisers could be taught to know some of the limitations and difficulties of the artist. He quoted the example of a Director of a company who had refused to accept the design of a show card containing a cerise, on the ground that he could never tolerate that colour, would not have any cerise-coloured flowers in his garden, and would not allow his wife to wear that colour.

He agreed with Mr. Purvis that an art school on the lines which he, Mr. Purvis, had suggested, would do a tremendous amount of good. Personally he had had experience of the ordinary art schools and of a professional artist's school, and he had learnt more at the latter in three months than he had learnt at the former in three years.

He thought far better advertisements would appear, and far more good designs would be sold, if it were not for the fact that many firms of printers sent round designs to their customers for which, apparently on the face of it, they did not charge. He knew a great many advertising men who would not buy a design from a recognised commercial artist because they foolishly thought that they were getting a design through their printers for nothing.

THE LECTURER, in reference to Mr. Ashbourne's remarks, said he had had a good deal of experience of poster ballots, but he had never yet found that the winning poster had any degree of artistic quality at all, mainly because the people who competed started out by saying, "Which do I think is going to be first?" instead of saying, "Which do I myself like best?" Most people had no conception whatever of what a poster was designed for, what was its idea, or anything else about it. They forgot it was a telegram and not a dissertation. People did not stand about the pavement in front of a hoarding and start reading a novel; it

was the poster that "got over" in the shortest space of time, and which carried its message from the eye to the brain, and remained there, which counted.

To establish a school for advertisers would be difficult, as the people who most needed such a school would be those who were most against it, as they would think that, being the persons who paid the piper, they were entitled to call the tune, and would refuse to give their time to learning what the tune was about, or how it was played.

As to printers' free designs, any artist in the commercial art world would give a very lurid opinion on that!

MR. F. W. BURROWS said there were many people who found it fashionable after they had raised themselves to a degree of eminence which permitted of a certain loftiness of air, to turn round and abuse the schools from which they had come. He could assure those present that the art schools of this country were whole-heartedly with artists in trying to get business men interested in the matters concerned. It was difficult, however, to get business people to take the advice of artists; it was too commonly thought that artists were merely idealists.

Mr. Purvis was wrong in believing that commercial art was an unwanted thing in art schools, but if people who could not draw at all went to an art school and wanted to be made commercial artists in six months, the school would probably discourage them. He thought Mr. Bradshaw, for instance, assumed that the people who went to him had some knowledge of draughtsmanship anyhow. There were art schools which were really trying to deal with this problem, but no school would be found which would give such a complete equipment to a man as to make him an artist such as, say, Mr. Purvis. It would be asking rather too much of the art schools to expect them to do that. A person had to go into the workshop, and to mix with printers, foremen, and everyone else concerned, in order to get to know what they were thinking about. It was not quite fair to suggest that everything was wrong in the art schools.

Referring to posters, a good poster was something of an æsthetic earthquake. It had to make people look at it whether they wanted to or not. One had only to look at the pictures which decorated the walls of the Royal Society of Arts to see what he meant. Those mural decorations might be excellent works of art, but they would have no value as posters.

One man who had done a good deal to raise the poster art of England and who had not been referred to by the lecturer, was Mr. Frank Pick.

The most important paragraph of the paper was probably the last one. If those present had had nothing else read to them but that, they would have been amply repaid for the time spent there that evening.

THE LECTURER said Mr. Burrows had taken him to task for talking about commercial art being an unwanted thing in art schools. In that connection he drew Mr. Burrows's attention to what he had said in the paper upon that point. If anyone asked him for advice as to which school to go to, he always suggested that they could not do better than go to the County Council evening classes to start with. He had started there himself, and he had nothing but praise for the efforts which were made there to help the student in every side of his work, but sometimes the master was not quite up-to-date in his methods. The difficulty was that there were so few teachers and so many students. The school he wanted to see established was one which would take on the student after he had finished with the orthodox art school, and give him an insight into the experience and policy which lay behind advertising schemes and agencies.

MEETINGS OF OTHER SOCIETIES
DURING THE ENSUING WEEK.

MONDAY, MAY 13. Architects: Royal Institute of British Architects, Strand, W.C. 8 p.m. Annual General Meeting.

East India Association: at Carlton Hall, Westminster, S.W. 4.30 p.m. Mr. A. Lathin. A National Script for India.

Geographical Society: at the Aradian Hall, New Bond Street, W. 8.30 p.m. Mr. I. B. Worthington. 'The Life of the Albert Nyanza and Lake Kioga.'

University of London: at the London School of Economics, Houghton Street, W.C. 5.30 p.m. 'Some Modern Philosophies of History' (Lecture III). Mr. R. G. Collingwood. Springer.

At the Royal School of Mines, South Kensington, S.W. 5.30 p.m. Prof. J. de Margerie. 'Some Aspects of French Tectonics' (Lecture III).

At University College, Gower Street, W.C. 5.30 p.m. Prof. H. I. Baker. 'Geometry: A Brief Review' (Lecture III).

TUESDAY, MAY 14. Anthropological Institute: 5, Upper Bedford Place, W.C. 8.30 p.m. Dr. R. J. Ashley-Montagu. 'The Tarsian Hypothesis in the Dentition of Man.'

Civil Engineers: Institution of, Great George Street, S.W. 6 p.m. Annual General Meeting.

Engineering Society: at the Hotel Victoria, Northumberland Avenue, W.C. 8.30 p.m. Sir Henry Fowler. 'Motors, Trains, and their Importance to the Development of the Empire.'

Illuminating Engineering Society: at the H. M. Office Industrial Museum, Horseferry Road, S.W. 4.30 p.m. Mr. G. H. Wilson. 'The International Commission on Illumination.'

Petroleum Technologists: Institution of, at the Royal Society of Arts, Adelphi, W.C. 5.30 p.m. Mr. G. B. Maxwell and Dr. R. A. Wheeler. 'Flame Characteristics of Fuel-oil and Non-Petroleum Fuels' (Part II).

Quackett, Mrs. J. and Child: 11, Chancery Street, Coventry Square, W. 6 p.m. Dr. H. A. Bach. 'The Histories of Parasitic Worms.'

University of London: at King's College, Strand, W.C. 5.30 p.m. Sir Bernard Pares. 'Contemporary Russia' (Lecture III).

WEDNESDAY, MAY 15. Engineers Society: at Burlington House, W. 8 p.m.

Iron and Steel Institute: at the Mappin Hall of the University, Sheffield. 6 p.m. (1) The Hon. Sir Charles Parsons and Mr. H. M. Dunn. 'A New Method for the Production of Sound Steel.' (2) Third Report of Committee on Heterogeneity of Steel Products. (3) Mr. G. A. Hankins and Miss G. W. Ford. 'The Mechanical and Metallurgical Properties of Spring Steels as revealed by Laboratory Tests.' (4) Mr. T. B. Phil. 'The Oxidation of Iron and Steel at High Temperatures.' (5) Mr. G. R. Kobosov. 'Brittleness in Mild Steel.' (6) Mr. H. Sutton. 'The Influence of Pickling Operations on the Properties of Steel.'

Horticultural, Royal Society of, at Bloomsbury Square, W.C. 4.30 p.m. General Anniversary Meeting. 5 p.m. Ordinary Meeting.

Meteorological Society: 41, Cromwell Road, S.W. 5 p.m. (1) Messrs. J. Edmund Clark, J. D. Margary, R. Marshall, and C. J. P. Cave. 'Report on the Phenological Observations in the British Isles, December 1927 to November 1928.' (2) Mr. D. Brunt. 'The Index of Retraction of Damp Air and the Optical Determination of Lapse-rate.' (3) Dr. I. Reginald Ashworth. 'The Influence of Smoke and Hot Gases from Factory Chimneys on Rainfall.'

Microscopical Society, 20, Hanover Square, W. 7.30 p.m. (1) Messrs. E. Heron-Allen and Arthur Harland. 'Some New Foraminifera from the South Atlantic, No. 1.' (2) Mr. Robert Paulson. 'The Form of the Chromatophore of the Bright Green Conidium common to many Lichens.' (3) Mr. David Bryce. 'On Three Cases of Emucation among Rotifers.'

University of London, at King's College, Strand, W.C. 5.30 p.m. Prof. Henri Hauser. 'The Modernity of the Sixteenth Century' (In French) (Lecture II). At the London School of Economics, Houghton Street, W.C. 5 p.m. M. le Professeur H. Berthelmy. 'The Role of the Conseil d'Etat in France.' Dr. Hubert Hall. 'The Nature, Value and Uses of English Judicial Records as Sources of Economic and Social Information' (Lecture III). At University College, Gower Street, W.C. 5.30 p.m. Lektor Rolf Pande. 'Norwegian Ballads' (Lecture II).

THURSDAY, MAY 16. Chadwick Public Lecture, at the Royal Society of Arts, Adelphi, W.C. 5.15 p.m. Sir Norman Walker, M.D. 'The Progress of Dermatology over 5 years.'

Chemical Society: Burlington House, W. 8 p.m. (1) Mr. T. M. Lowry. 'The Validity of Drude's Equation.' (2) Mr. A. I. Vogel. 'The Dissociation Constants of Organic Acids.' Part I. 'The Primary Dissociation Constants of some Alkyl Malonic Acids.' (3) Messrs. T. M. Lowry and W. V. Floyd. 'The Properties of Nicotine and its Derivatives.' Part I. 'Molecular Extinction-coefficients.' (4) Messrs. T. M. Lowry and W. V. Floyd. 'The Properties of Nicotine and its Derivatives.' Part II. 'Optical Rotatory Power and Rotatory Dispersion.' (5) Mr. A. I. Vogel. 'The Dissociation Constants of Organic Acids.' Part II. 'The Primary Dissociation Constants of some Cyclic and Dicarboxylic Acids.'

Electrical Engineers: Institution of, at Trinity College, Dublin. 4.45 p.m. Annual General Meeting.

Mineral and Metallurgical, Institution of, at Burlington House, W. 5.30 p.m.

University of London: at King's College, Strand, W.C. 5.30 p.m. Dr. Stanley A. Cook. 'The Religion of the Old Testament in its Historical Setting' (Lecture III).

5.30 p.m. Mr. Hor. J. Evans. 'Avarian Reform in the Danubian Centre' (Lecture III). (King's College) at 40, Torrington Square, W.C. 5.30 p.m. Dr. Julian Krzyznowski. 'Sir Walter Scott and the Origins of the Historical Romance in Poland' (Lecture II).

At the London Hospital Medical School, Whitechapel, E. 5.30 p.m. Prof. J. J. R. Macleod. 'The Physiology of Glycogen' (Lecture I).

At the London School of Economics, Houghton Street, W.C. 5 p.m. Mr. Georg Igendahl. 'The City and the Bank of England.'

At St. Thomas's Hospital, Albert Embankment, S.E. 5 p.m. Prof. S. J. Cowell. 'Diabetes' (Lecture III).

At University College, Gower Street, W.C. 5.30 p.m. Prof. J. Petersen. 'Faust' (In German) (Lecture II).

FRIDAY, MAY 17. University of London, at King's College, Strand, W.C. 5.30 p.m. Prof. Henri Hauser. 'The Modernity of the Sixteenth Century' (In French) (Lecture III).

5.30 p.m. Prof. A. Mawer. 'Problems of Place-Name Study in the Light of Five Years' Work of the English Place-Name Survey' (Lecture III).

At the London Hospital Medical School, Whitechapel, E. 5.30 p.m. Prof. J. J. R. Macleod. 'The Physiology of Glycogen' (Lecture II).

At University College, Gower Street, W.C. 5.30 p.m. Lektor Rolf Pande. 'Norwegian Ballads' (Lecture III).

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 3991.

VOL. LXXVII.

FRIDAY, MAY 17th, 1929.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.(2.)

NOTICES.

TWENTY-FIRST ORDINARY MEETING.

WEDNESDAY, MAY 8th, 1929. PROFESSOR W. ROTHENSTEIN, M.A., Principal, Royal College of Art, in the Chair.

A paper entitled "War and the Arts" was read by MR. CHARLES J. FFOULKES, O.B.E., F.S.A., Curator of the Armouries, Tower of London. The paper and discussion will be published in the *Journal* on July 19th.

ALDRED LECTURES.

MONDAY, MAY 13th, 1929. LIEUT.-COL. SIR ARNOLD T. WILSON, K.C.I.E., C.S.I., C.M.G., D.S.O., in the Chair

SIR E. DENISON ROSS, C.I.E., Ph.D., Professor of Persian and Director of the School of Oriental Studies, University of London delivered the last of his course of four lectures on "Nomadic Movements in Asia." On the motion of the Chairman a vote of thanks was accorded to the lecturer for his most interesting course. The lectures will be published in the *Journal* during the summer recess.

INDIAN SECTION.

FRIDAY, MAY 10th, 1929. SIR E. DENISON ROSS, C.I.E., Ph.D., in the Chair

The Sir George Birdwood Memorial Lecture was delivered by CAPTAIN P. JOHNSTON-SAINT, M.A. (Cantab.), F.R.S. (Edin.), I.A. (retd.), of the Wellcome Historical Medical Museum, his subject being "An Outline of the History of Medicine in India." The lecture will be published in the *Journal* on July 26th.

PROCEEDINGS OF THE SOCIETY.

FIFTEENTH ORDINARY MEETING.

WEDNESDAY, MARCH 13TH, 1929.

DR. WILLIAM HENRY ECCLES D.Sc., F.R.S., in the Chair.

THE CHAIRMAN, in introducing the lecturer, said that if the Royal Society of Arts had arranged a meeting on loud speakers, say, fifteen years ago, the small audience that would have been attracted would have come mainly from those interested professionally in telephone engineering. On the present occasion there was a very big audience, which illustrated the fact that nowadays the general public knew the term "loud speaker" very much better than they had done fifteen years ago; in fact, it had now become a household phrase.

He ventured to think that the loud speaker was really only beginning its triumphs, and that as the years went on it would become a more and more familiar feature, rivalling, perhaps, in the long run the printing press itself.

He had heard many uncomplimentary remarks about loud speakers. To begin with, the very name excited prejudice. It suggested that it could never be "sweet and low." He imagined, however, that everyone present was a loud speaker lover, otherwise they would not have come. Therefore he hoped the lecturer would be kind to their favourite instrument and tell them all the pleasant things he could about it. As a matter of fact, the lecturer had studied very deeply not only the good habits, but also the vices of the instrument. Therefore it could not be expected that nothing at all derogatory would be heard about it. He hoped, however, that the audience after listening to the lecture would still be able to go away saying, "In spite of all thy faults I love thee still," or not still.

The following paper was then read:--

LOUD SPEAKERS AND THEIR DEVELOPMENT.

By R. P. G. DENMAN, M.A., A.M.I.E.E.,
of the Science Museum, South Kensington.

More than six years have elapsed since the inauguration of Broadcasting set up a world-wide demand for a powerful electrical instrument which should be capable of imitating at a moment's notice the human voice, a violin, a tinkle, a crash, a piano, a drum, or a complete orchestra. Scientifically this demand was noted at the time as a request for "a multi-frequency single-phase motor coupled to an air-pump, operating on current of frequencies varying from about 50 to 10,000 cycles per second, and voltages varying in somewhat the same ratio."¹ It is the purport of this paper to take stock of the situation as it stands to-day; to put into general circulation a few of the opinions and ideas that have been freely communicated by workers in various

¹ *I.E.E. Journal*, Vol. 62, p. 811. The statement was probably intended to apply to the "Equal Audibility" system of transmission then in fashion.

laboratories, and to suggest by demonstration and argument the extent to which some of these hopes have been fulfilled and others may still be justifiably entertained.

Because of its agreeable associations, the art of Sound Reproduction, like that of Photography, will be acknowledged to possess a twofold appeal. There are interesting theories about the latent image, or the behaviour of transients ; there are valuable metrical experiments for those who have the necessary apparatus, but above all there are always some *results* to be observed, even though they cannot always be admired. We are, for the most part, however, fortunate in the possession of eyes and ears which are willing parties to a considerable amount of deception, so long as this is not exposed too ruthlessly or too often. It may be that we have just discovered that our camera is oblivious to the existence of red and yellow, or that our 1923 pattern loud speaker is dumb from middle C downwards, yet we can still obtain some pleasure from either, until the superior merits of panchromatic film (or of the moving coil loud speaker) stand out too forcibly for us to ignore them any longer. We accustom our eyes to false colours and our ears to false tones. Knowing them to be false we accept the picture they give us as a sort of convention, and we are often sceptical at first about accepting a fresh convention, even though it approach more nearly the ideal. But however faulty its judgments, and however often it may be induced to reconsider them by logical demonstrations of error, the ear remains the deciding factor in the final verdict on any loud speaker. And since human ears and musical preferences differ greatly, there is generally some residue for discussion left over after the simplest test. It is not as if we could assemble the requirements for a perfect loud speaker in precise order of importance and then attend to them in that order. For example, assuming that many imperfections are at present inevitable, some people would say that resonances must be kept down at all costs ; others, that the chief thing to aim at is a wide range of frequency response, on the ground that resonances must abound in any room where music is played and that a few more small ones do not matter. It will, therefore, be convenient at this stage to gather together a number of more or less familiar facts which will be admitted to bear closely on the subject of sound reproduction.

Sound is a form of energy, produced by the vibrations of bodies and propagated as waves in an elastic medium, such as the air. Speech and music are organised, artificial sounds. A *pure tone* is essentially a single sinoidal vibration. Its pitch is determined by the frequency ; the intensity of the sound, as measured by some uniformly sensitive apparatus, by the air pressure that it creates. A *complex tone* is a fundamental tone with the addition of one or more overtones, again sinoidal in form. Overtones may or may not have frequencies which are exact multiples of the fundamental. Those which do so are called harmonics.

Transients are disturbances associated with changes in the amplitude of a complex tone, e.g., the beginning or the end, or else occurring as independent pulses of sound. There is much evidence^a that the relative phases of the fundamental and the overtones in a sustained, complex tone are of no practical importance to the ear in judging its character. With regard to transients, any sound whatever could theoretically be simulated to any desired degree of perfection by the process of correctly adding together a sufficient number of pure tones, but the question whether phase is here important appears not yet to have been finally disposed of, though it seems highly probable. Mr. L. C. Pocock, who has made a preliminary study of the rather formidable mathematics of the problem in its relation to telephony, finds that a good steady-state response characteristic implies also that the response to transients is good.^b He argues that an ideal frequency-response characteristic, linear from zero to infinity, would necessarily mean that there was no change of phase angle with frequency. And so the evident possibility, that the ear cannot obtain a true impression of a transient disturbance unless the original phases are preserved intact, need not be held to introduce any element of doubt as to the ability of such a system to respond perfectly to all sounds, for the phases would remain undistorted in any case. But since the frequency-response curves of physically realisable systems do not extend over an infinite range, there remains the question whether such curves (plus curves of amplitude) are competent to define uniquely the quality of reproduction obtainable from the system which they represent; and if the answer be yes, then whether the attainment of a perfectly flat characteristic would be accompanied automatically by freedom from phase distortion. In other words, if we take care of the frequencies, will the phases take care of themselves? Or conversely, is the introduction of phase-correcting networks a key to the obtaining of better frequency-response curves? Mr. E. K. Sandeman is of the opinion that phase distortion *can* occur in a system which has been rendered free from resonance. He has also put forward the interesting suggestion that the proper reproduction of transients requires that the system shall be responsive to all frequencies down to zero, and he is actually prepared to provide a method of radiating this latter "frequency" as a continuous air pressure, by moving the end wall or curtain of a room!

While applauding the boldness and resource of this last proposal it is important not to lose sight of Mr. Sandeman's real point, which is that the analysis of the Fourier integral corresponding to any transient pulse may

^a See, for instance, Lloyd and Agnew, "Effects of harmonics upon acoustic quality," *Bulletin of the Bureau of Standards*, Vol. VI, p. 225, wherein Helmholtz's famous contention receives further experimental support. Phase distortion in long transmission lines due to different velocities of propagation for the different frequencies is, of course, another matter.

^b L.C. Pocock, "Faithful Reproduction in Radio Telephony," *I.E.E. Journal*, Vol. 62, p. 804.

involve component vibrations whose periodic time is longer than that of the sustained tone with which it may happen to be associated, and that, in any case they will contain one vibration of the same duration as the pulse itself. This being so, it is clear that we should revise our ideas concerning the lower range of frequencies to which loud speakers should, if possible, be made to respond. These have hitherto been commonly regarded as being governed wholly by the following kind of considerations. The range of frequencies occurring in speech extends from about 60 to above 6,000, or over about seven octaves out of a total of ten comprising the entire audible range. The range of fundamental frequencies produced by sustained tones in music extends from 16 to 8,000 in organs, but this latter frequency, though it is produced by the fundamental tone of one pipe, is only used to reinforce the upper partials of other pipes. Excluding the organ, the range is from about 30 (pianoforte double bassoon, bass tuba) to nearly 4,000 (piccolo, violin). Riding on top of these fundamental tones are their overtones, giving the characteristic quality or timbre of the sound. These vary in intensity—for example, from 99.7 per cent. for the second harmonic of a fundamental piano note of frequency 512, to 1.5 per cent. for the eighth harmonic of a violin note. Above 5,000 there is a rapid dwindling of intensity in the partials of sustained musical tones, but it would be mistaken to infer from this that their psychological importance is proportionately reduced. For many persons, the squeak of a slate pencil or the note of a mosquito, however faintly heard, are capable of producing a strong emotional effect. After centuries of development, extremely high frequencies are produced by some musical instruments, and whether or not these instruments would be better without some of them, it may fairly be presumed that reproduction will be considered more or less imperfect when they are absent. The purpose of a loud speaker is presumably to reproduce sound, not to effect improvements, and to decry (on insufficient evidence) the æsthetic value of frequencies which cannot yet be reproduced is surely to make a virtue of necessity.

It has been customary to state the "ideal" upper frequency limit as 10,000, but it seems that even this is too low to secure absolute perfection. I have already stated that organ pipes having a fundamental frequency of 8,000 are regularly made. I have lately been informed by a well-known firm of organ builders that it is possible for them to distinguish differences in the tonal quality of two different kinds of these pipes. Assuming that this difference is due to the amount of second harmonic present, the "ideal" limit cannot safely be put below 16,000.

Arising out of a suggestion made by the author, the British Broadcasting Corporation recently carried out an experiment to determine the minimum percentage of second harmonic which it is necessary to superpose on a pure tone for the effect to become noticeable on an ordinary loud speaker. For this purpose an electrical generator of pure tones was employed, and it was

arranged that the output from this and from an associated frequency-doubler could be fed in measured quantities to the loud speaker. The results of the experiment are given in the following table, the first column showing the frequency of the pure tone and the second the percentage of second harmonic required to produce a noticeable change in the quality of the note emitted by the loud speaker

Frequency of Fundamental			Percentage of second harmonic required for audibility.		
900	...	...	...	...	3
2,000	...	...	...	...	4.3
3,000	...	...	...	...	5.3
4,000	...	...	...	...	16.7
5,000	...	...	...	...	49
6,000	...	...	...	...	72.7
7,000	...	...	...	...	140

It may thus be taken as settled that if 50 per cent. of second harmonic is present in a complex tone of 5,000 cycles it will affect the ear, even after passing through a present-day loud speaker; while the statement concerning organ-pipes shows that there are true harmonic effects (to say nothing of valuable transient components) occurring at frequencies of 10,000 and higher.

As regards practical possibilities, it is well known that neither in gramophone recording (for mechanical reasons) nor in broadcast reception (because of congested channels) does there exist at present any widespread or satisfactory source of supply for loud speakers containing frequency components much above 5,000.⁴ This used to be regarded as sufficient to secure reproduction of very high quality, but as it has been definitely ascertained that the suppression of frequencies above 7,000 brings about a noticeable degradation of quality in some present-day loud speakers (none of which, however, have good efficiency in this region) it seems evident that it would be better to reserve the expression "high quality" for the proper reproduction of all frequencies up to about 8,000.

Certain peculiarities of the ear remain to be noted. Some of these conspire to make us "hear" sounds that are not physically present and to miss others that are. Experiments by A. M. Mayer⁵ in 1876 drew attention to the fact that the aural sensation of even intense high tones may be obliterated or "masked" by the presence of lower tones. Hence, higher harmonics, if they do not attain a certain minimal intensity, might just as well be absent altogether, and the experiment previously cited is clearly to be regarded as

⁴ This is only possible at present with an insensitive receiver situated close to a good broadcasting station. But the limitation may be removed long before loud speakers have improved sufficiently to reap the benefit.

⁵ Mayer, *Phil. Mag.* 11, 500, 1876. See also R. L. Wegel and C. E. Lane, *Electrical Communication*, Vol. III, p. 43. "The auditory masking of one pure tone by another and its probable relation to the dynamics of the inner ear."

one more proof of this. It has been found, on the other hand, that when the fundamental (and even several of the harmonics) are removed from a complex tone by filtering, the ear continues to apprehend the pitch of the sound as that of the missing fundamental, though its quality does not remain unimpaired. This single fact has allowed millions of horn-type gramophones and loud speakers to come into being, which must otherwise have been found totally useless for the reproduction of music.

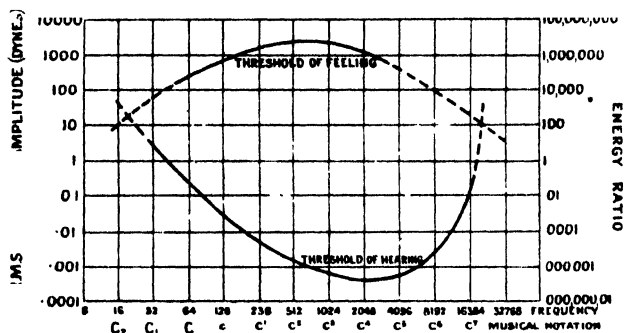


FIG. 1. Curve showing Auditory Sensation area.

Fig. 1 shows the auditory sensitivity of the average human ear.* The lower curve represents the minimum sound pressure audible at different frequencies. The upper curve shows the extreme values of loudness at which the ear begins to experience the sensation of feeling rather than of hearing. The two curves enclose the area of audition. At the upper and lower limits of audition it takes about a hundred million times as much energy to enable one to hear as it does in the middle region, but the energy required is never very great, and the calculation is sometimes quoted that if a million people talked incessantly for an hour and a half they would only give out enough energy to make one cup of tea.

According to a generalisation variously styled "Weber's Law," "Fechner's Law," or the "psycho-physical law," the increase of stimulus necessary to produce an increase of sensation in any sense is not a fixed quantity, but depends upon the proportion which the increase bears to the immediately preceding stimulus. It is expressed by Fechner in the form:—The sensation increases as the logarithm of the stimulus. The law is approximately true in the case of sight, hearing, pressure and the muscular sense, but most exactly in the case of sounds of medium frequency. It follows, that just as there are sounds too weak to be heard, so there are changes in the volume of an audible sound too small to be perceived, and these changes are greater, the greater the initial loudness. This is considered by the majority of workers to justify the

* R. L. Jones, "The Nature of Language," *Electrical Communication*, July, 1923, p. 38.

plotting of frequency-response curves on a logarithmic basis. While agreeing that this is probably the best convention to adopt, it is due to those who oppose it to point out that Fechner's law cannot be taken as having any direct application to two sounds of different pitch. A logarithmic scale does however, have the desirable effect of making a "good" loud speaker look good, so that the harsh, uncompromising and no less arbitrary linear scale is best kept for those who are definitely on the look-out for troubles. Accordingly, it is becoming customary to chronicle the results of a loud speaker test in the form of a graph in which the abscissae are sustained musical tones, or (which is the same thing), frequencies plotted logarithmically, while the ordinates representing the energy of the sound at some chosen point are also plotted logarithmically, and often in terms of Decibels, or "Transmission Units." Two values of sound energy, P_1 and P_2 , are said to differ by N Transmission Units where

$$N = 10 \log_{10} \frac{P_1}{P_2}$$

Although $\frac{1}{2}$ T.U. represents about the minimum audible change in the energy of a pure tone, a sudden difference of 3 T.U. in the power radiated by a loud speaker when reproducing speech or music would not be more than just audible. This represents a change of one hundred per cent., as shown in the following table:—

Number of T.U.				Approximate Power Ratio. (Gains)
1	...	...	...	1.25
2	...	...	...	1.6
3	...	...	...	2
4	...	...	...	2.5
5	...	...	...	3.2
6	...	...	...	4
7	...	...	...	5
8	...	...	...	6
9	...	...	...	8
10	...	...	...	10
20	...	...	...	100
30	...	...	...	1000

Besides responding uniformly at all frequencies, good loud speakers must be free from amplitude distortion; that is to say, that the energy they radiate should be strictly proportional to, and of the same frequency as the energy with which they are supplied. One would naturally expect to find that the energy from a horn or diaphragm would not be radiated evenly in all directions, and it is well known that actual frequency-response curves taken in different

positions round a loud speaker exhibit wide variations. Nor is this all. The sound pressure due to a diaphragm loud speaker (to take one example) does not obey the inverse-square law at distances greater than $\frac{D^2 f}{4500}$ feet, where D

is the diameter of the diaphragm and f the frequency.' The position of the microphone used for taking the curves must be chosen with due regard to this and to the inevitable formation of standing waves. (This may make it desirable to swing the microphone.) These, and many other variable quantities which are known to enter into the highly complicated mathematical equation that finds expression in the frequency-response curve, have recently been most ably dealt with by L. G. Bostwick in an article entitled "Acoustic Considerations involved in Steady State Loud Speaker Measurements."⁸ It is to be feared that they are such as to render all but nugatory the publication of frequency-response curves without a detailed account of the manner in which they were taken. This is obviously impossible in the present paper, where a number of such curves have been assembled from many different sources, and it would therefore be imprudent to compare any two of them, except in the most general way as regards approximate frequency range, etc. And I would add that only those who have plotted such curves can realise quite how much difference is created by a friendly (or malicious) choice of scales.

Returning after this digression, it has been noticed that, in taking response curves of gramophones, exceptionally good results are sometimes obtained, indicating that the quality of certain reproductions should be approaching perfection. In every case, however, the trained ear has rebelled at such a suggestion and has refused to be taken in under really rigorous test conditions. A possible clue to this mystery has recently been found in the Research Laboratories of the Gramophone Company. By taking particular care in their measurements they have disclosed the existence in these response curves of a fine, peaky structure, which with normal methods of measurement has been concealed by the presence of stationary waves and by the sluggishness of the apparatus used. Since these peaks are too small to have any noticeable effect upon the reproduction of steady tones, one is rather driven to conclude that their action is to degrade the reproduction of transients by unequal treatment of the different components.

It would be outside the scope of the present paper, and of its author's mathematics, to take the discussion of transients far beyond this point. But the subject does not appear to have received sufficient attention and it is hoped that further theoretical and experimental investigations may be stimu

⁷ Backhaus and Trendelenburg, "The Directional Effect of Piston Diaphragms," *Zeitschrift f. Techn. Physik.*, Vol. 7, pp. 630-635, 1926.

⁸ *Bell System Technical Journal*, January, 1929, p. 135.

lated by these remarks and especially also by the work of Küpfmüller* in the theory of transient phenomena as applied to voice-frequency telegraphs. In the meantime, it is evident that there are insufficient data to enable anyone to specify the tolerances that can be allowed to exist in the performance of a "perfect" loud speaker. All that can be said is that something short of an exact reproduction of the original binaural sound effects would probably be accepted by the ears, and, in the absence of any knowledge of deception, by the brain. But we know this already, for most people have been taken in *once or twice* by an unusually good piece of loud speaker reproduction, while I have even heard of a man offering one a cigarette. So that it becomes necessary to have recourse to methods of trial and error, and the history of loud speaker development begins in this way. But whereas the ear was at first the only judge, sound measurement and electro-acoustic theory have now reached a stage when more reliance can usually be put upon their indication than upon aural results.

Among early loud speaking devices, Edison's "Electromotograph" is usually mentioned. In this, a mica diaphragm is linked with a metal friction disc, bearing on the surface of a chalk cylinder which is kept moistened with potassium iodide or caustic potash. The telephonic currents pass from the disc to the cylinder and give rise to an increase or decrease in the force of friction between them, by virtue of the electrolytic action. The cylinder is rotated by hand and the resulting force is transmitted to the diaphragm. It is said that the device was capable of giving out speech at great intensity, but although in experiments with it at the Science Museum we have succeeded in obtaining moderately loud results and a small percentage of intelligibility, I do not think that it could have been very successful in daily operation. It is mentioned here on account of its 50-year old connection with the first telephones, and also because it made use of a principle which has been employed several times since then—the idea of a friction-relay, in which small mechanical forces control considerable local power. The same principle was adopted in the Johnsen-Rabek electrostatic loud speaker, an example of which, constructed by Mr. A. A. Campbell-Swinton, F.R.S., is also in the Museum. The last loud speaker of this class to be made was the "Frenophone," designed in 1923, by Mr. S. G. Brown, F.R.S.

More successful than the friction relay is a device which I may call the "sluice-gate" system, to distinguish it from the "paddle" or air-pump principle utilised in the vast majority of loud speakers. Examples of this are Sir Charles Parsons' Auxetophone and Mr. Gaydon's Stentorphone, in both of which a stream of air issues from a high-pressure source through a valve controlled by the vibrations. Both these devices were originally made

* K. Küpfmüller, "The Building-up Processes in Wave Filters," *Elektrische Nachrichten-technik*, 1924, Vol. 1, p. 112. See also W. Cruickshank, "Voice-Frequency Telegraphs," *I.E.E. Journal*, 1929

as gramophones, and both gave very good results. Some small difficulty appears to have been experienced from the hissing sound of the escaping air, but it has been suggested that this problem could probably be solved in the light of more recent knowledge, by careful matching of the acoustic impedances and perhaps by introducing a low-pass acoustic filter into the system. If this were done it is possible that a very good loud speaker for public address work could be made.

Edison's need to avoid the Bell telephone patents in 1878 led him to design the chalk-cylinder receiver which I have described, and when it was found that this would speak loudly, the point was naturally emphasised. But the literature of the years which followed contains very little mention of loud-speaking telephones, for which there was naturally no very great demand. Such instruments as were made usually took the form of a Bell telephone receiver of rather larger dimensions than usual, having in particular a big diaphragm. A typical use for them was found during the War, in portable field telephone exchanges for making audible the morse buzzer call of some distant subscriber. It is not widely known that a telephone receiver much older than Bell's is in existence. This is the "Telephon" of Philip Reis, made in 1863. His transmitter was very imperfect, but his receiver, which was extremely simple, was less so. It depends upon the effect known as magnetostriction, and consists merely of a steel knitting needle, mounted on a wooden box and wound with insulated wire. The needle lengthens and contracts with the magnetising current and communicates its vibrations to the box. Quite recently G. W. Pierce has found that the effect persists even at radio frequencies, so that short metal rods can be used to replace quartz oscillators,¹⁰ while Dr. A. P. Harrison, of H.M.S. "Vernon," has constructed a loud speaker on this principle. It is at once the oldest and perhaps the most novel of those that I shall show this evening.

Returning to the Bell telephones, it is, I suppose, probable that the addition of some sort of horn would follow without conscious invention, but it was, nevertheless, a very important step forward. The pronounced resonance of the diaphragm of a Bell telephone, when tensioned against the pull of its permanent magnet (without which all tones, if audible, would be heard an octave higher) are partially damped when the receiver is held to the ear. But if a Bell movement is used as a loud speaker this resonance is very lightly damped and the result is a weak and uneven transfer of energy to the air. By the addition of a properly proportioned sound chamber and horn the diaphragm is damped in an efficient manner, since the added load is realisable as sound energy. This stage of development—a Bell telephone movement with a short horn of conical or flared shape (which had already been reached by the gramophone in 1912)—was naturally attained very rapidly in the case of the loud speaker when a real demand was created by the inauguration of Broadcasting,

¹⁰ *Proc. American Institute of Radio Engineers*, Jan. 1929.

and many such instruments were made. Many, indeed are still used, and it is the mournful truth that they are often a desperate remedy for a desperate disease. A typical frequency-response curve for a loud speaker of this type is shown in Fig. 2, from which it will be seen that the range of useful reproduction is from about 200 to 3,000 cycles per second, with many severe resonance peaks. For reasons of indifference, ignorance or financial stringency, as the case may be, there are at the present time thousands of obsolete wireless receiving sets so bad that almost any loud speaker is better for them than one which tells the horrid truth. By multiplying the resonances, and by partly ignoring the fictitious harmonics spued out by these shocking sets, the

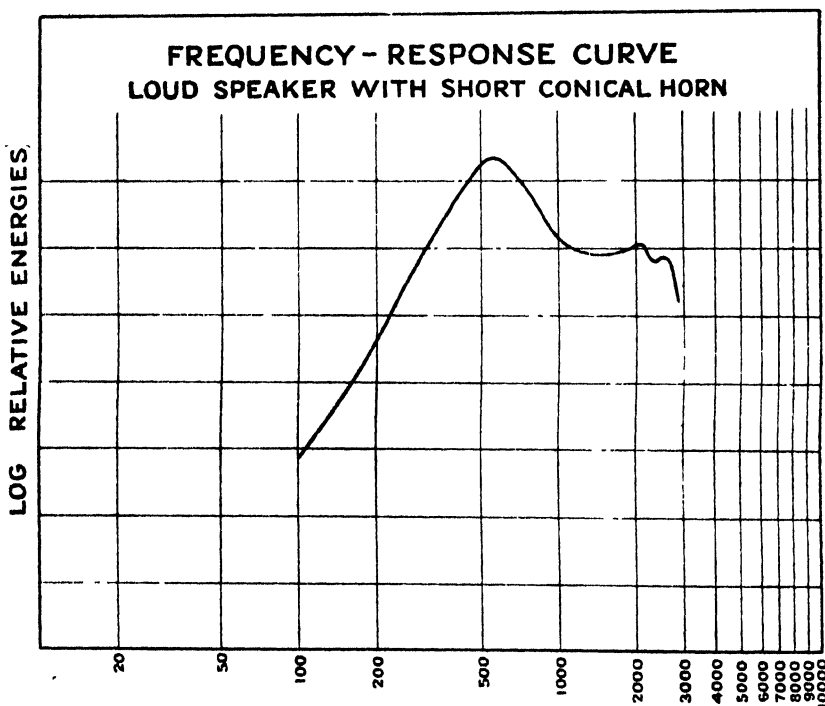


FIG. 2.—Frequency-Response Curve. Loud Speaker with short conical horn.

loud speaker of yesterday does actually perform the melancholy service of postponing its own funeral and that of its outworn associate.

It came as a surprise to most people when theory and experiment confirmed the fact that these loud speakers, in common with the gramophones of the period, were constitutionally incapable of radiating sound at any frequency below about that of middle C (256), a result which the actual experience of

listening made it difficult to credit, until attention was drawn to the friendly assistance given by the ear in reconstructing a mutilated complex tone when presented with a sufficient number of the pieces. This was hailed optimistically by some as a dispensation from further efforts towards extending the bass response of loud speakers. Others felt that something was wrong, but could not prove conclusively that the quality of the bass thus introduced by aural irregularities was actually different to that of bass notes which were really "there." Even now there are differences of opinion concerning the lower range of frequencies which it is necessary to cover in order to obtain perfection of reproduction of steady tones.

Some time ago the Bell Telephone Laboratories prepared a series of gramophone records showing the effects produced by drastic suppression of the low and high frequencies in speech and music, and by the courtesy of the Gramophone Company, I am able to reproduce them this evening. Listening to these records one is irresistibly reminded of the early phonographs and pre-war gramophones, and it must be admitted that some of the examples of high-tones loss are getting uncomfortably near home—even now.

To-day it is well known that in order to obtain good bass reproduction from loud speakers with small diaphragms, horns of great length are necessary. The advantages of a logarithmic horn, in which the cross-sectional area is an exponential function of the distance measured along the axis, were noted by A. G. Webster many years before Broadcasting commenced. Such horns were studied in detail by Hanna and Slepian, and by P. B. Flanders, and were immediately utilised for loud speakers and gramophones, to the great advantage of both. Although the length of a logarithmic horn is not a fundamental constant in the design, it is nevertheless true that the longer the horn is made the lower will be the range which a given instrument either gramophone or loud speaker, will cover, and in practice skilful folding is necessary in order to confine the horn within the limits of even a large drawing-room cabinet. Even then the lowest note that can be satisfactorily reproduced is one having a frequency of about 90, which still leaves something to be desired, as many people can testify. A loud speaker of unusual interest will later be demonstrated in conjunction with a 15 ft. exponential horn.

Up to the present, no diaphragms or driving units have been mentioned other than the original Bell telephone. It was pointed out that the fundamental drawback of this arrangement is the fact that the diaphragm is initially stressed by the attraction of the permanent magnet, and that it must be tensioned against this force, with the result that resonances occur in conjunction with the mass of the diaphragm. The resonances could be partially suppressed by mechanical damping, but only at the expense of efficiency, which in any case is very low and of the order of 0.1 per cent., rising to about 10 per cent. for the undamped resonance.

By the avoidance of a rigid damping round the edge of the diaphragm it

is possible to drive it as a piston or plunger, and in place of many resonant frequencies there is then only one, due to the mass and stiffness of the diaphragm and its suspension. This type of diaphragm is best driven by other means and will be referred to later.

It will be evident that greater freedom of choice in the size and material of the diaphragm would result if it were not also called upon to discharge the functions of an armature, and equally, that improvements in the armature would follow if its form were not restricted to a flat circular iron disc.

In 1910 Mr. S. G. Brown patented his well-known telephone receiver, in which the flat diaphragm was replaced by a light aluminium cone, very flexibly supported round its edge, and driven from its apex by a vibrating reed armature. When the idea of separating the functions of the diaphragm and the armature was applied to a loud speaker, the problem of securing an adequate and even response at all important frequencies was still present. The reed and the small cone or diaphragm attached to it necessarily possessed separate natural frequencies, when combined there were at least two, and the designer did his best with these. Unfortunately he could not do justice to the bass, for the reed itself could not be made sufficiently flexible to enable it to respond to low frequencies without making the movement as a whole too insensitive for practical use.

About 1923 a new form of loud speaker began to appear, having a large flat or cone-shaped diaphragm of paper, driven by a light rod attached to a reed armature. One of the earliest of these loud speakers, the *Lumi re*, was demonstrated at the Institution of Electrical Engineers in November, 1923. The conditions were not very favourable and perhaps the instrument did not receive sufficient credit at the time. It was the first loud speaker to give an impression of bass response, and though this bass was undoubtedly largely spurious and unnatural, it was, I think, the best instrument of its period.

The next event of importance was the introduction of the Western Electric Company's cone loud speaker. This was capable of reproducing much lower tones than a horn type instrument of normal size, and its resonances in the middle and upper frequency regions were less marked, but the quality of the amplification obtainable with the average broadcast receiver was still so deplorably bad that the horn type was often preferred. The main features of the Western Electric Company's instrument were patented in 1925. The radiating system is arranged in the form of two cones joined at their bases. One of the cones is truncated, leaving a large aperture at the back of the instrument. The sole support is by clamping round the edge of this aperture, so that the outer edge of the diaphragm is not fixed. The frustum portion acts partly as a vibrator and partly as a baffle, preventing neutralisation of air pressure between back and front. The actuating mechanism was based on the Baldwin telephone movement and consisted of a magnetically balanced reed, pivoted between the extensions of a large permanent magnet, and

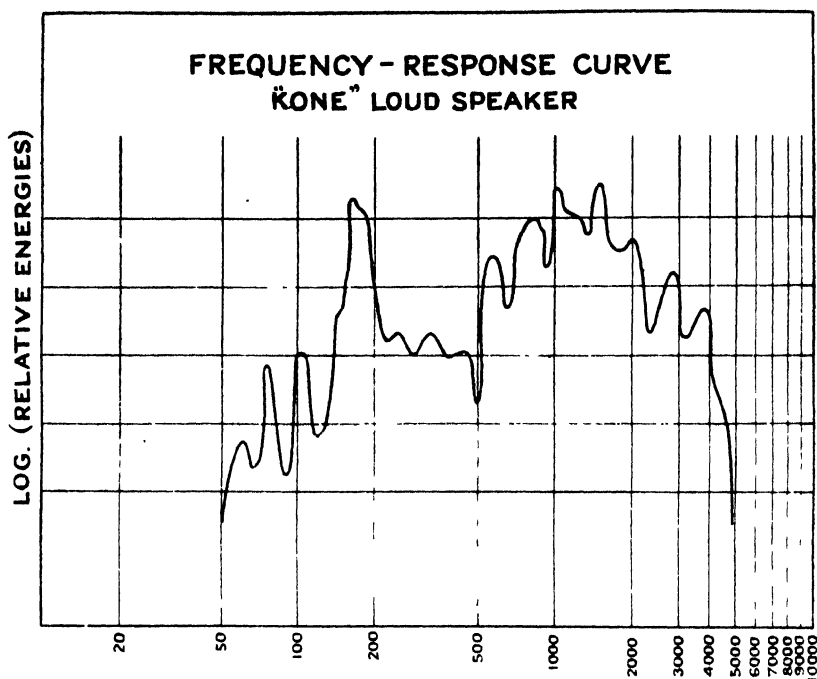


FIG. 3.—Frequency-Response Curve, "Kone" Loud Speaker.

surrounded by a small coil through which the current passed. The movement was mounted inside the hollow space of the diaphragm, and a long rod connected it to the apex of the front cone. A frequency-response curve of this loud speaker is shown in Fig. 3. This was the first instrument in which any conscious attempt was made to apply the new principle of *impedance-matching* which was then making its way into vibrational mechanics. The principle was based on G. A. Campbell's invention of the electric wave filter. It has revolutionised the gramophone and a knowledge of the principles involved is of constant value in electro-acoustics. Expressed in general terms, the theory permits of the virtual annulment of resonance effects. Any sudden change in the impedance of a mechanical or electrical system prevents the free transfer of energy across the junction. Some of it is reflected back, with the result that stationary waves are formed and resonant effects produced. By arranging the various parts of the system so that they form repeated similar sections of predetermined form it is possible to ensure that over a wide range of frequencies electrical or mechanical vibrations are transmitted with small and constant attenuation. Every section of such a filter structure considered separately, has a pronounced

resonance, but when properly terminated the system as a whole has not. Either high-pass, low-pass or band-pass filters can be constructed, and these can be designed for electrical, mechanical or acoustic vibrations, while formulae are available for the design of mixed structures in which energy is transformed from the first of these forms into the second, and from the second to the third, without serious reflection at any point. These principles are of such great importance that some time has been devoted at the Science Museum to the construction of slow-working filter models. One of these, a mechanical band-pass filter, is now to be demonstrated.* This filter has been designed to pass vibrations of frequencies lying between 7 and 12. It nearly (but not quite) suppresses all others as the theory requires for this type.

A proper terminating resistance is essential to a filter and is very difficult to obtain mechanically. In the model an approximation to this is given by a glass cylinder with perforated end-plates, inside which a light piston is driven to and fro. Acoustically, it is given also by an infinitely long tube, and by a finite exponential horn for all frequencies above the cut-off in the lower region. The model shown has been purposely designed to have also an upper cut-off frequency, and it may serve here to demonstrate the impossibility of obtaining uniform velocity response at all frequencies in a mechanical system operating under constant force.

Before passing on to a consideration of other types of loud speaker, it is interesting to note that a new type of reed instrument has recently appeared, in which the designers have attempted to compensate for the non-linear relation between the applied force and the resultant motion (which is inherent in most reed-type instruments) by turning to account the slight flexing of the reed armature under varying magnetic attraction. So far, no experimental results (other than those which anyone may obtain by listening) are available from which it would be possible to judge the extent to which these (and other) claims are justified, but failure to secure this linear relation is common in reed-type loud speakers and is necessarily accompanied by amplitude distortion and the production of harmonics not originally present. Fig. 4 shows two response curves for this loud speaker. Curve "A" was taken in Germany; Curve "B," taken in England, is for another instrument of the same construction and it is interesting to note the extent to which they agree. But it must be emphasised that the degree of correlation between a "typical" frequency-response characteristic and the truth is no greater than that which is found to exist between the characteristics of any two specimens taken by two equally trustworthy methods.

Shortly after the introduction of the reed-driven cone came news of the development of the now well-known moving coil hornless loud speaker. The principle of this form of drive had been used as long ago as in 1894 by

* The demonstration was followed by a short slow-motion cinematograph film in which the phase-shifts in each filter section could be followed.

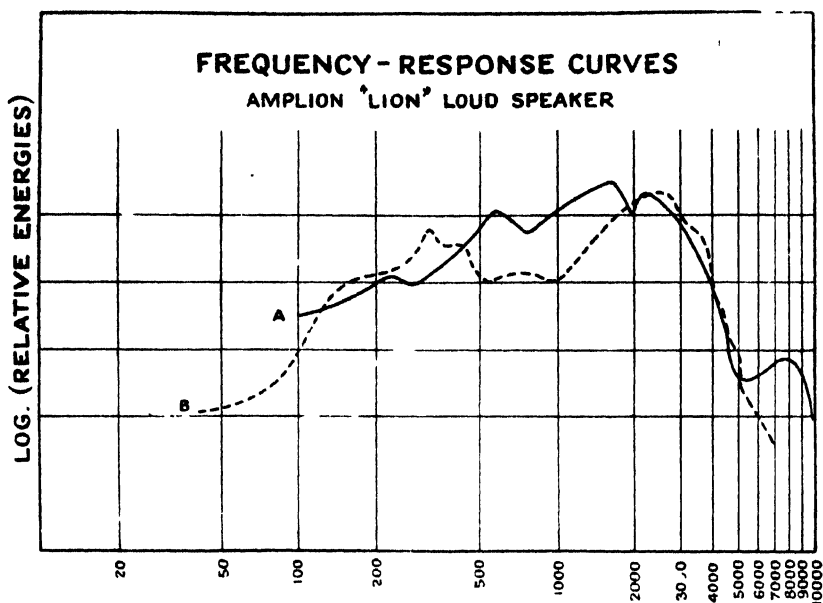


FIG. 4.—Frequency-Response Curves. Amphon "Lion" Loud Speaker.

Sir Oliver Lodge, who connected the moving coil to the diaphragm of a microphone and so caused it to actuate a second coil, connected to a further microphone. This in turn operated a third coil which carried a light wooden disc forming the loud speaker diaphragm. In this way he obtained a sensitive microphone relay for weak wireless signals transmitted by the induction method. Portions of the apparatus have been found and presented to the Science Museum by Sir Oliver Lodge and these are exhibited.

The moving coil principle possessed the outstanding advantage that the movement could be made proportional to the current over a very wide range, while large amplitudes could be obtained at low frequencies without loss of sensitivity at other frequencies. It had already been applied to the construction of horn-type loud speakers, and was again utilised by C. W. Rice and E. W. Kellogg in the design of their well-known free-edge cone loud speaker. The first approximate theory of this instrument was based on the assumption that a cone, which is freely suspended round its edge and driven by a coil at the apex, will vibrate equally and in phase at all points. The cone is surrounded by a large baffle and therefore resembles, in theory at least, the case given by Lord Rayleigh for a flat piston-like diaphragm, situated in a large rigid plane surface. Rice and Kellogg, following H. Riegger, pointed out that if a rigid conical diaphragm, small in comparison with the shortest wave-

length considered, were controlled in its movements by its inertia, and if it were driven by a constant force at all frequencies, the sound output would be independent of the frequency. As regards the requirement of rigidity, they appear to have thought that this could be maintained approximately up to a frequency of 2,000, but actually it is doubtful whether (with the material they used) the condition holds for any but the very lowest frequencies, and in some experiments by the British Thomson-Houston Company, who viewed the cone through a Rotoscope, bell-like vibrations were seen to occur at a frequency of 50 cycles. Again, the expression "small in comparison with the shortest wave-length considered" means in practice that a 6-inch cone ceases to be "small" at a frequency of 300 or less. This upsets the balance at high frequencies, but the breaking up of the diaphragm is probably a much more serious matter.

However, the actual performance of this type of loud speaker was found to be vastly superior to that of previous instruments, and especially was this true of the reproduction of low tones, as would naturally be expected from the type of drive used. Here lies the chief merit of Rice and Kellogg's work, that for the first time it became possible to produce a loud speaker of moderate size which could reproduce the bass with some approach to fidelity. A large baffle or cabinet was certainly necessary to prevent air circulation and consequent neutralisation of the low tones, but this, as well as the provision of a powerful field magnet, can generally be provided where a horn long enough to produce equivalent results would be out of the question.

The moving-coil loud speaker has been extensively studied in this country by Dr N W McLachlan, The B.T.H. Company, Capt H. J. Round, Capt. A G D. West, Mr P. K. Turner, and others too numerous to mention. Dr McLachlan was the first, and with his permission a loud speaker designed by him was made and installed at the Science Museum in 1926 for use in conjunction with a high-quality receiving set presented by the B B C. It is believed that the demonstrations given there daily over a period of three years, together with the enlightened action of the leading wireless journals in the publication of authoritative information, have done much to improve the standard of reproduction in this country, though it is unfortunately still true that really good results are beyond the means of many of those who are most anxious to achieve them. For domestic use a cone of six inches diameter is very satisfactory. Larger cones are more efficient, and Fig 5 shows a frequency-response curve for a large moving coil loud speaker. The principal features of all coil-driven cone characteristics are : - (1) a low resonance, due to the diaphragm and its suspension, which should be kept as loose as other circumstances will permit ; (2) a fairly steady rise in output up to a maximum which may occur at about 3,000 cycles ; and (3) a rapid falling off in the higher frequencies. The numerous alterations which can be made in the size, material, or angle of the cone, or indeed any of the variables, only affect the character-

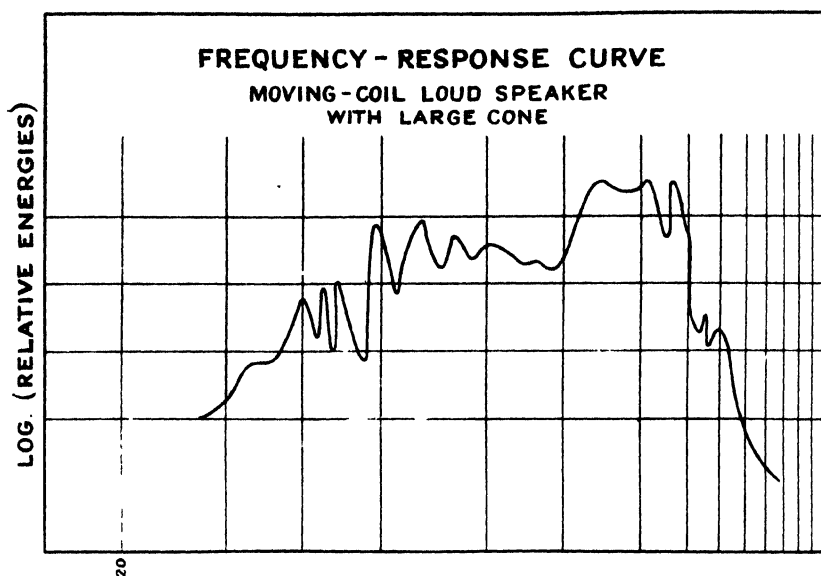


FIG. 5.

istics in a subsidiary manner, and the general form remains the same. It is therefore advantageous to introduce into the amplifying system some simple form of correction circuit, such as a resistance and condenser connected in series across the terminals of one of the anode resistances. This, if correctly chosen, will have the effect of reducing the height of the main resonance peak without affecting the response at the upper and lower extremities of the curve.

A common defect in the reproduction of these loud speakers is a tendency to give too much prominence to the bass, which then sounds "boomy." There are a number of possible causes :—

(1) The cabinet, or, in a less degree, the baffle, may resonate. The former should be a mere skeleton frame, covered with gauze, otherwise this trouble is bound to be experienced.

(2) The cone itself (in combination with its elastic support) is undoubtedly largely responsible. The reason is not quite obvious, however, for the response curves show that the resonance peak is much less severe than the main resonance around 3,000 cycles, whereas the ear is many thousand times less sensitive at the lower frequency. The radiation resistance of the cone is here, however, extremely small, and the cone, which is constantly set in motion at this frequency by transient components, will continue to vibrate with a decay

factor $\frac{R}{2M}$, where R is the total resistance and M the mass, for a long time after the initial impulse has ceased. It is probable that the ear has become accustomed to associate a slow decay period with a loud original sound, and thus receives the impression of a more pronounced resonance than actually exists.

(3) At low frequencies the amplitude of the diaphragm motion is large and there is a tendency for the restoring force to become non-linear with the amplitude. The effect of this is to produce harmonics, and these may be radiated with comparatively great efficiency, causing the ear to reconstruct a powerful subjective fundamental tone.

Thus it seems probable that the "boom" in these instruments is due to a number of contributory causes all tending the same way. It should be pointed out, however, that the loud speaker is not always entirely to blame. One of the few defects of the well-known Reisz microphone is that it over-accentuates the bass, and the trouble is likely to be less noticeable where a condenser microphone is employed. It is understood that these are now in service in certain transmissions from the London station.

Dr. N. W. McLachlan has pointed out that when the speech coil is in motion a voltage is induced in it, the effect of which may be represented by a motional impedance in series with the static impedance of the coil. In the ideal case where the coil is unrestrained, this impedance may be represented by a condenser. The effect of the supports, however, is to change the phase of the induced voltage, so that at the resonant frequency the motional impedance becomes a pure resistance. When the restoring force of the support increases rapidly with the displacement it is possible to get two or more resonant peaks in the displacement curve, and where the change is very sudden a region may be found where, for a fixed frequency, the cone can be made to vibrate with one of two different amplitudes, the change from one to the other being brought about merely by touching it.

From what has been said it will be evident that it is scarcely possible to make the suspension of a coil-driven cone as free as could be desired, and also that it is impossible to indicate any portion of its response curve where the instrument behaves strictly according to Lord Rayleigh's theory. It is, indeed, fortunate that a small paper cone can be persuaded to put up even a passable imitation of the sounds we desire to hear, and it would perhaps be unreasonable to complain if nothing better should ever be evolved for domestic use. Most of the loud speakers which remain to be noticed are at present either too large or too expensive for this purpose.

The Schlenker loud speaker, which with associated electrical reproducing apparatus has been kindly lent for demonstration by the Gramophone Company, consists of a large disc of duralumin, stretched radially nearly to its elastic limit and driven eccentrically by a moving coil of some 20 ohms impedance.

This coil is similar to that used in the Western Electric Company's Type 555 W Loud Speaker described at the end of this paper. With so large a diaphragm, partial vibration is bound to take place and the Gramophone Company have obtained some interesting sand figures, which are being shown to-night as lantern slides. The frequency-response characteristic is somewhat similar to that of the coil-driven cone, and, in addition, the acoustic output is large.

Of special interest are those loud speakers in which the force is applied evenly over the whole of the moving surface. For some reason they appear to have been rather neglected in this country, but their *a priori* merits are obvious. The electrostatic method is very suitable for the purpose, but as the sensitivity of such a speaker depends upon the polarizing voltage (and since the permanent "electret" shows no signs of leaving the laboratory stage at present), there is nothing in an electrostatic instrument to take the place of the permanent magnet in an ordinary loud speaker but a source of high potential. This was most ingeniously applied in one of Herr E. Reisz's loud speakers by transforming up, rectifying and smoothing a small proportion of the speech current itself. While visiting Berlin last summer the author had an opportunity of listening to a large Reisz electrostatic loud speaker and formed a high opinion of its capabilities. The special feature of this instrument is the diaphragm, which is of elastic material upon which is deposited a thin layer of metallic powder. Each particle behaves as an elementary diaphragm of very high natural frequency.¹¹

The Statophon of Vogt-Engl-Massole was an earlier electrostatic loud speaker which has since been developed into a powerful auditorium instrument and is now used by the Tri-Ergon Company.

There are other methods of obtaining uniform vibration over a large surface. The Hewlett loud speaker employs a conducting diaphragm placed between two flat coils.¹² The speech currents are superposed on the magnetising current in these coils and induce eddy currents in the diaphragm, causing it to vibrate uniformly in the field. The power required is stated to be considerable and this is also true of the "Blatthaller" and "Falzlautsprecher," electrodynamic instruments, all of which, however, have the same desirable feature of approximately uniform vibration over their entire radiating surfaces. Fig. 8, taken from a German publication, is a response curve of the large Blatthaller. This instrument weighs about 5 cwt. The diaphragm, of corrugated duralumin sheet, is in three sections and carries a perpendicular zig-zag winding of copper strip which lies in the gap of a 300-watt field magnet of similar shape.

Not unlike this in construction is the new (and seemingly excellent) "Riffel-falter" instrument; but here the "winding" consists of a straight wire located in a long, narrow magnetic gap. This instrument, like the Blatthaller, is of German origin. That nation is also responsible for an experimental loud

¹¹ *Radio Technick und Export (Hiltos)*, No. 43, 1927, p. 137

¹² Hewlett, "A New Tone Generator," *Phys. Rev.*, Vol. 19, p. 52.

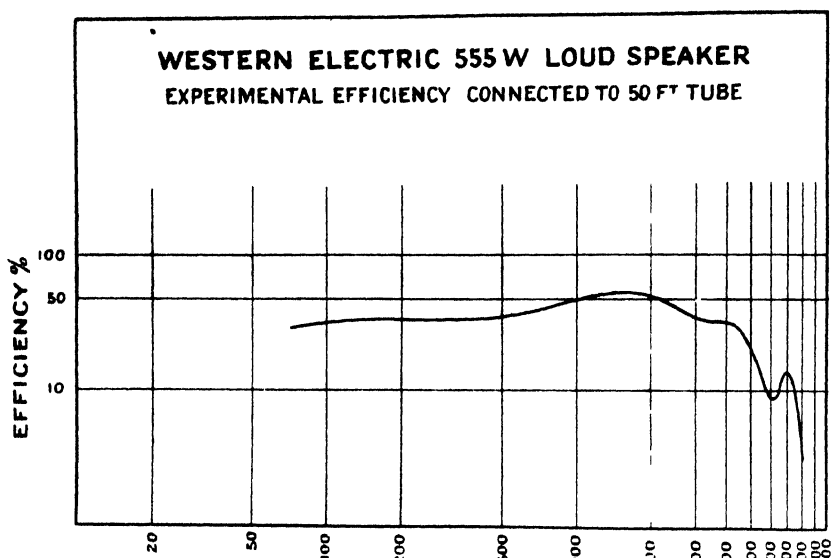


FIG. 6

speaker of great interest, for it has no moving parts as these are ordinarily understood. This glow discharge loud speaker of Breuzinger and Dessauer,¹³ however, requires the application of a steady potential of 10,000 volts, and is at present of only academic interest.

The efficiency of all the loud speakers described, as measured by the ratio of the acoustic output to the electrical input, is very poor. The horn type loud speaker, however, is capable of surprising efficiency under certain conditions, as is shown by Fig. 6, which gives the efficiency of the Western Electric Company's Type 555 W Loud Speaker, designed in America by E. C. Wentz and A. I. Thuras.¹⁴ This curve was taken with the instrument connected to a 50-foot tube, and the efficiency is seen to be in the neighbourhood of 50%, which is only 3 T.U. below the theoretical maximum of 100%. This loud speaker is of the moving coil type, the coil consisting of a single layer of aluminium ribbon 0.015 inch wide and 0.002 inch thick, wound on edge and separated by a film of insulating material about 0.0002 inch thick. This type of construction has a number of advantages. It is self-supporting; ninety per cent. of the volume is occupied by metal, and heat is rapidly conducted away. The air chamber and diaphragm are shown in Fig. 7. The coil is attached edgewise to the diaphragm (a form of construction used some

¹³ *Phys. Zeit.*, 29, p. 264.

¹⁴ *Bell System Tech. Journal*, Jan., 1928, p. 140.

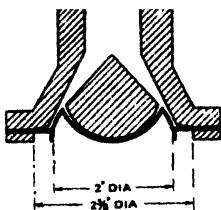


FIG. 7.—Air chamber and diaphragm of Western Electric Company's Type 555 W Loud Speaker.

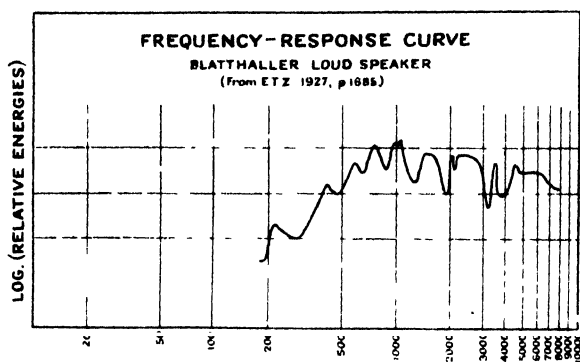


FIG. 8.

years ago by Captain Round in his coil-driven horn loud speaker). The diaphragm, which is very flexibly supported and driven plunger-fashion, is dished, and a conical obstruction placed close up to it en-ares that the disturbances reach the throat of the horn approximately in phase up to high frequencies.

This loud speaker is claimed to be capable of handling about 5 watts of electrical energy with an average efficiency in practice of 30%. It is in commercial operation in this country in conjunction with the "Movietone" and "Vitaphone" talking film systems, and is to be demonstrated this evening with a 15-foot exponential horn having a calculated low-frequency cut-off at about 60 cycles.*

Bearing in mind the remarkable improvements that have been made during the six years under review, it would obviously be unwise at this stage to assume the mantle of prophecy. Science in general appears to have reached a stage at which, given the necessary funds, means can be provided to deal with almost any problem that is not fundamentally insoluble. It may be that the absence of

* During the subsequent demonstration, attention was drawn to the unusually faithful reproduction by this instrument of *crescendo* and *diminuendo* effects in music. It is thought that the failure of many loud speakers to secure this result may be due to the use of too large an input in relation to the strength of the magnetic field.

a true binaural effect constitutes one such limitation, but the imperfections of present-day materials in regard to strength, stiffness, permeability and so forth are probably more important. With the huge financial resources of the gramophone and motion-picture industries to foot the bill, it is probable that the most striking developments of the future will be made in the large auditorium instruments, and that the small domestic loud speaker will either remain in its present form or else will gradually give place to small-scale examples of these types. When one considers the size and cost of a pianoforte in relation to its average domestic usefulness, fifty pounds or so will not seem much to pay in the future for an instrument which, I dare say, will be more capable than it is at present of sustaining the many rôles that are demanded of it.

The author desires to express his very sincere thanks to the following organisations for their generous assistance in lending apparatus for demonstration :—Messrs. Standard Telephones and Cables, Ltd., the Gramophone Company, Ltd., the Chloride Electrical Storage Company, The British Thomson-Houston Company, Ltd., The Edison-Swan Electrical Co., Ltd., The M.O. Valve Co., Ltd., The General Electric Co., Ltd., and the British Broadcasting Corporation ; also to the following gentlemen for their valuable help and advice in the preparation of the paper :—Mr. J. R. Benson, Mr. H. L. Kirke, Mr. L. C. Pocock, Mr. E. K. Sandeman, Mr. A. Whitaker, Capt. H. J. Round, Capt. A. G. D. West, Capt. B. S. Cohen, Mr. F. G. Davey, Mr. P. K. Turner, Mr. A. G. Garton, Mr. R. E. H. Carpenter, Mr. A. P. Harrison and Mr. F. E. Godfrey. Thanks are likewise due to Col. Sir Henry Lyons, F.R.S., for permission to exhibit objects from the Electrical Communication section of the National Science Museum.

DISCUSSION.

THE CHAIRMAN, in opening the discussion, said one point which had struck him was that in discussing loud speaker theory a great deal of attention was paid to the Fourier analysis of the motion of the diaphragm and of the air. It seemed to him that too much analysis could be indulged in. Those interested could, if they liked, and perhaps they ought to, forget that the diaphragm was really an alternating current motor with a large range in frequencies and with a large range in amplitudes, and that it could be said to vibrate simultaneously with a great many frequencies, which were harmonic or not harmonic, to a fundamental. It seemed to him that they could with advantage forget a good deal of that and concentrate attention on the essence of the matter, namely, to attempt to make the diaphragm of a loud speaker move in exactly the same way as the ear-drum (which was another diaphragm) of a listener to the original orchestra. Imagine an orchestra sending out very complex waves of sound and those waves falling on the ear-drum, the ear-drum performed a very complicated motion, and if that motion could be reproduced exactly in the diaphragm of a loud speaker the waves emitted by it would have the same effect as the waves that came from the orchestra.

and there would be no need to descend to minute analysis. That was the way to look at it ; it set the ideal before one and it saved thinking about the displacements in phase which no doubt took place if a loud speaker failed to operate exactly in the manner he had suggested.

The question of phase displacement had been raised in the paper. It was closely associated with the binaural sensation ; that was to say, it was thought that the difference in phase of the sounds heard by the two ears was what gave a person a sense of perspective and direction acoustically. In the gramophone and in the broadcast loud speaker one had instruments which were essentially monaural ; they were one-ear instruments, because when the record was being made, or when the microphone was picking up the sound waves in the studio, it acted as one ear of a listener. Therefore when the reproduction took place from the gramophone record or from the wireless receiver in the home, what was reproduced was what would be heard by a one-eared man. Although a person listened to it with two ears, it was essentially not binaural, and therefore there was a great loss in respect of perspective, perception of distance and direction, when one listened to any loud speaker.

One point which had been raised, but not elaborated and which might be further discussed, was that in the old-fashioned loud speaker consisting of a small conical trumpet the absence of practically all notes below 300, or below middle C, was made up by the ear supplying a fundamental. The reason for that was not clearly known. Taking the fundamental as 100, this, and the harmonic 200, would be cut off because they were below 300. So that the first harmonic one heard of the collection was 300 ; the next was 400, and the next 500. Those notes seemed to be able to reproduce in the mind of the listener the 100, even although it was not present ; and, as the lecturer had said, that had enabled a lot of loud speakers to be sold in olden days which probably would not have been sold had it not been for that dispensation of Providence.

Why did the ear supply the deficiencies ? Some people said it was because difference tones were formed. The difference between the 300 and 400 was 100. That difference tone could be shown to be mathematically formed in such circumstances in the ear bones, or in the structure of the ear, or it might be that it was formed subjectively as a psychological phenomenon. But there was a difference tone between 300 and 400, between 400 and 500, and between 500 and 600 always one hundred difference ; and that was perhaps sufficient to account for the whole of the phenomenon.

The lecturer had referred to another point which had caused much controversy in the past and on which many different opinions were held, and that was whether music, mellowed by a gramophone horn, was or was not better than the original music, which contained, if there was a bad violin, many harsh overtones. There were many people who said that the flavour of canned salmon was much better than the flavour of a fresh Scotch salmon. Personally he could only admit that it was different ! But the same theory could be applied and was applied to the subject under discussion, and he had heard it said seriously on many occasions that the mellowing effects of the horn was a thing to be desired and perpetuated. Until there had been available that latest instrument from America, he thought a great many people might have swallowed that hypothesis, but he fancied that the lecturer's demonstration of the delights of true reproduction would put an end to those imaginings.

MR. C. G. GARTON (British Thomson Houston Co.) said that strictly speaking what he had to say did not come under the heading of a contribution to the

discussion. What he hoped to do was to demonstrate an apparatus which he had present by which could be obtained actual response curves of loud speakers projected on a screen. Everyone present must have realised, when the lecturer had been performing the "squeak" experiment with various loud speakers, that it had been impossible to hold in the mind for any length of time what the response of the loud speaker had been at different frequencies. One's memory for sound was very poor, and in order to do any serious work in the way of scientific measurement on the subject, one had to have some form of apparatus which would produce the results either as a curve or as a series of readings. This, however, was a laborious task, because the curves had an enormous number of peaks and valleys, and to follow each out was a very laborious job indeed. They had led a colleague and himself to devise an apparatus which would project the curve automatically, so that it merely came to turning a handle and picking out the points on the paper.

(Mr. Garton then proceeded to describe and demonstrate the apparatus.)

At the conclusion of his demonstration Mr. Garton said he would like to refer to the question of transients, as the Chairman had made reference to phase of transients which he had applied to binaural hearing. That had not been the point which the lecturer was attempting to emphasise--and it was a point which should not be emphasised at the present stage. Leaving aside all questions of binaural hearing, the point was as follows: Supposing one had a sound which was not a musical note, but an explosive consonant like "T" that presumably consisted of one sinusoidal pulse of a certain high frequency plus a series of associated higher harmonics. The point was whether the loud speaker separated out the fundamental pulse from the others and allowed them to be emitted from the loud speaker at different times. It was quite conceivable that the harmonics might be a whole cycle in front of or behind the fundamental pulse, leaving out of question all difference of phase between two ears. Looking at transients in that way seemed to be of extreme importance, and that was one direction in which improvements were to be looked for in future loud speakers.

MR. R. W. PAUL remarked that he had been requested by the lecturer to present that evening for the first time a loud speaker on which he had been working for the past few years. When he had started making moving coil instruments in 1891 it had been for a different purpose, but many of the difficulties which now arose in the case of the moving coil loud speaker had arisen in the early days of moving coil instruments for measuring purposes. He had felt that he had known nothing about telephony, so he had gone to his old friend and collaborator, Captain Cohen, at that time in the Research Department of the Post Office, and the inventor of the method just demonstrated. They had decided, after discussing the subject, that they would endeavour to approach the ideal in regard to the moving element of a loud speaker of the moving coil type. That had been expressed correctly by Lord Tomlin as a weightless, rigid, flat disc. He had present with him a loud speaker which consisted of a disc eight inches in diameter. The weight of the disc itself was ten grammes. If it was supported at the edges and loaded in the middle with a kilogramme, the deflection was a fraction of a millimetre.

(Mr. Paul then proceeded to describe the instrument in detail, and concluded by a demonstration of its powers.)

CAPT. B. S. COHEN (G.P.O.) said he desired to show a response curve for the loud speaker which had just been demonstrated. That curve was plotted on the principles laid down by Mr. Bostwick in a paper in the *Bell System Journal*. He

agreed it did soften the blow as compared with a curve purely of pressure, but one point which had not been made clear with regard to the method was that one was working to a constant base line, because the response, as defined by Bostwick, was the ratio of the acoustic power output at any point to the electrical power input as referred to a hypothetical loud speaker operated at the same point.

(Capt. Cohen then threw the curve on to the screen and explained its significance.)

One other point he would like to refer to was with regard to perfection in reproduction. That was one of the most interesting points which had been raised that evening. It appeared on first sight that a loud speaker which had a perfect frequency response over the whole audio range and freedom from non-linear distortion, might give perfect reproduction; but he was inclined to disagree with that, certainly with regard to orchestral reproductions. The reason for that, he thought, was indicated to a very great extent by what one might call the external non linear distortion as applied to the internal non-linear distortion due to the focussing

(Capt. Cohen then proceeded to expound the point by means of a slide on screen.)

MR. G. G. BLAKE, M.I.E.E., F.Inst.P., said there was one point in the paper in particular which he thought the man in the street had to thank the lecturer for bringing to his notice, and that was the doubtful value of frequency response curves which, as the lecturer had shown, were so open to friendly or malicious choice. Personally he considered that while frequency-response curves were of enormous value and should be studied by engineers and scientists who were seriously engaged in research work, it was far better for the man in the street simply to use his ears and be satisfied with the loud speaker which pleased him best. A person would do far better to hear a number of loud speakers and make his choice by ear, than to rely upon published curves.

The lecturer had stated that the first horn loud speaker was dated about 1910, but he (the speaker) remembered that a man named Johnson had a horn type of loud speaker in use at Shepherd's Bush as long ago as 1903 or 1904. It was, however, a very peculiar type of instrument, above its electro-magnetic poles it had the prongs of a tuning fork in lieu of a diaphragm, and it was employed in a system of "secret wireless telephony." One had to speak on one note all the time, and if one succeeded in so doing, some kind of more or less understandable reproduction could be heard from the horn of the loud speaker. It might interest the audience to know that Johnson had described and illustrated his loud speaker in a book called *Electric Flashes* (published in 1904). Johnson was, he believed, originally a teacher of music, and there were some remarkable passages in this little book. In it he described Marconi (who at that time was endeavouring to transmit across the Atlantic) as "a young man with great ambitions." In another part of the book Johnson argued "that, if one placed a wet duster between the poles of an induction coil, the current would be drawn down to it in the form of a brush discharge; therefore, how was it likely that Marconi could transmit his electric waves over the water of the Atlantic Ocean?"

MR. P. WILSON thought it might be interesting if he gave the earliest reference to a loud speaker that had ever yet been found. Siemens in 1877 had taken out a patent, No. 4685, for a loud speaking telephone which included a moving coil loud speaker of the modern type.

THE CHAIRMAN, in moving a hearty vote of thanks to the lecturer, said all present felt extremely grateful to the lecturer for the immense amount of labour and time

which he must have expended in the preparation of his paper and the demonstrations with which it had been accompanied—which demonstrations had all been excellent and successful. It was indeed hard to express in words their gratitude. There must have been, too, many negotiations with the original owners of the apparatus and also with Mr. Garton and Mr. Paul. For all that the audience thanked the lecturer. Especially did they thank him for the fact that he had managed to bring to their hearing for the first time in this country that wonderful newest triumph in the art of constructing loud speakers.

The vote of thanks was carried unanimously.

THE LECTURER, in acknowledging the vote, said he felt he was only entitled to receive a very small amount of the audience's kind applause; the rest should go to the many firms and individuals who had helped him so much.

NOTES ON BOOKS.

THE INSTALLATION OF ELECTRIC LIGHTING AND HEATING. By Frederic H. Taylor. London: Chapman & Hall, Ltd. 7s. 6d. net.

This treatise, bearing evidence all through of sound practical knowledge of the subject, is divided into six sections and nineteen chapters, filling 136 pages, and includes 154 illustrations or diagrams.

In connection with rubber-covered wires, a stretching test of the rubber is advocated; conduit systems are generously dealt with and explained in detail; cable and various proprietary metal-cased systems of wiring are fully discussed. Also the wiring of special positions, including the use of portable gear for shipyards, docks, etc. Ceiling roses, switches and plugs are analytically brought to the notice of the reader with good advice as to selection of suitable apparatus; some further advice might perhaps be given on the protection of flexible cords at plugs which are in frequent use, and the employment of aluminium fuse wire, which is finding favour, will perhaps be given a paragraph in a future issue.

Installation work, carried out on the general principles laid down in the book, will give satisfaction for a great many years.

C. A. B.

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

TUESDAY, MAY 21. University of London, at King's College, Strand, W.C. 5.30 p.m. The Most Rev. His Grace the Archbishop of Upsala, "The Church and Peace."

5.40 p.m. Sir Bernard Pares, "Contemporary Russia." (Lecture IV).

At University College, Gower Street, W.C. 5.30 p.m. Mr. Robin Flower, "Life, History and Folklore of a Kerry Island." (Lecture I).

WEDNESDAY, MAY 22. Eugenics Society, at Burlington House, W. 8 p.m. Discussion on "Family Endowment." Speakers: Prof. D. H. McGregor, Dr. R. A. Fisher, and Prof. T. E. Gregory.

University of London, at King's College, Strand, W.C. 5.30 p.m. Prof. Anathon Aall, "The Hellenistic Element in Christianity." (Lecture I).

At the London School of Economics, Houghton Street, W.C. 5 p.m. Dr. Hubert Hall, "The Nature, Value and Uses of English Judicial Records as Sources of Economic and Social Information." (Lecture IV)

5.30 p.m. Admiral Sir Richard Welch, "The Freedom of the Seas."

THURSDAY, MAY 23. Aeronautical Society, at the Royal Society of Arts, Adelphi, W.C. 6 p.m. Mr. A. F. Ford, "Liberation of Aircraft Engines."

Paradey Society, at Burlington House, W. 7.45 p.m.

Annual General Meeting. Discussion on Third (Experimental) Report to the Atmospheric Corrosion Research Committee (British Non-Ferrous Metals Research Association).

University of London, at King's College, Strand, W.C. 5.30 p.m. Mr. Hor L. Evans, "Agrarian Reform in the Danubian Countries." (Lecture IV).

At St. Thomas's Hospital, Albert Embankment, S.E. 5 p.m. Prof. S. J. Cowell, "Dietetics." (Lecture IV).

At University College, Gower Street, W.C. 2.30 p.m. Lecture on the Recent Discoveries of the British School of Archaeology in Egypt at Beth-peleth Palestine, by Prof. Sir Flinders Petrie.

FRIDAY, MAY 24. Physical Society, at the Imperial College of Science and Technology, South Kensington, S.W. 5 p.m. (1) Dr. Ezer Griffiths, "A Hygrometer for use in Timber Seasoning." (2) Dr. J. N. Vincent, "Experiments on Magneto-strictive Oscillations at Radio-Frequencies."

University of London, at Hirkbeck College, Bream's Buildings, E.C.4. 5.30 p.m. Prof. Sten de Ger, "Sweden and the North of Europe." (Lecture I).

At King's College, Strand, W.C. 5.30 p.m. M. Denis Saurat, "André Gide."

5.30 p.m. Prof. Anathon Aall, "The Hellenistic Element in Christianity." (Lecture II).

SATURDAY, MAY 25. Victoria and Albert Museum, South Kensington, S.W. 3 p.m. Mr. Hubert Langley, "Some English Poetry."

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 3992.

VOL. LXXVII.

FRIDAY, MAY 24th, 1929.

*All communications for the Society should be addressed to the Secretary, John Street
Adelphi, W.C.(2.)*

NOTICE.

TWENTY-SECOND ORDINARY MEETING.

WEDNESDAY, MAY 15th, 1929. MR. JAMES SWINBURNE, F.R.S., Past-President of the Institution of Electrical Engineers, in the Chair.

A paper on "The Reform of the British Patent System" was read by MR. ROBERT BURRELL, Barrister-at-Law. The paper and discussion will be published in the *Journal* dated August 2nd.

PROCEEDINGS OF THE SOCIETY

SIXTEENTH ORDINARY MEETING.

WEDNESDAY, MARCH 20th, 1929

LIEUT.-COL. SIR ARNOLD WILSON, K.C.I.E., C.S.I., C.M.G., D.S.O., in the Chair

THE CHAIRMAN, at the opening of the meeting, said that Lord Stanmore, who was to have presided, was unfortunately indisposed and unable to attend. Speaking as a layman, it was his conviction that, after cookery and housekeeping, architecture was the most vital, the most vivid, the most essential and the most living of all arts and crafts. Bacon had remarked that houses were made to live in and not to look at; but he was then speaking less truly than was his wont, perhaps, because he did not realise the growth of ten-storey skyscrapers. The lecture about to be delivered was of a most novel and interesting nature and it would be accompanied by a large number of slides, some of which had never been shown before, on several forms of modern English architecture.

The following paper was then read:—

MODERN ENGLISH ARCHITECTURE.

By A. E. RICHARDSON, F.S.A., F.R.I.B.A.,

Professor of Architecture, University of London.

Most English architects would like to see the general level of building raised. At this juncture a section of opinion inclines to the view that the past should be forgotten and all effort concentrated on the future

You will agree that this policy is very sweeping. In the first place the future depends upon the present, and as the present is the result of the past we return to the old process of evolution. In other words, we cannot escape from the myriad incidents which form, collectively, the basis of present-day civilisation.

When we examine the progress of the arts from the earliest times we find that the cycle from the primitive to the highly cultivated has been consistent with the development of the race. Art at various epochs has worked out its destiny from the primary to the stylistic. The sum total of the world's experiments in art is style. During the passing of the centuries the old structural integrity of the arts became obscured by style. There was bound to come a time when the plastic arts would become tired. There were signs of this "tired feeling" in the 19th century, when all the arts became imitative of old styles, the truth being that Democracy was learning to participate in reminiscences of good old things. During the past quarter of a century the arts have passed to a new stage of transition. The old has not been forgotten; it has merely been modified. Professor Lethaby describes this period of transition as a search for new rulings of structure. . . . He is right. We are trying to produce efficient buildings. The danger is that we may sacrifice beauty to efficiency. Fortunately, the weight of opinion inclines to a compromise between old and new, that is to say, in so far as the treatment of material goes. The new is inevitable, but it must be evolved; it cannot be anticipated. We may think for the time being that a factory style is the solution; we may incline to a steamer style, or merely an aeroplane style; we may even invent structural-looking buildings that have nothing to recommend them but novelty. The whole thing is debatable.

For my own part, I favour the policy of *festina lente*. It would be madness to discard scholarship, and equally futile to ignore the advances made in science. English buildings of the best type combine the qualities of old work with the freshness of new ideas; therefore I propose to take these works as models of this age of transition.

Art generally works out its own solution between two extremes. There is no doubt of the fact that the Arts are steadyding down to a new era of structural grace. It has been realised that thorough work lives. In architecture we do not require shibboleths and catch-phrases such as originality, modernism,

design, composition, style, etc., etc. We desire fine buildings. A formula for obtaining this result cannot be devised. How many painters could write an essay on how they purchased their own works? Lord Kelvin once asked a workman if he could explain electricity. "No, my Lord," was the reply. "Neither can I," said the great man. Inigo Jones was once commissioned to investigate the origin of Stonehenge, for which he was paid in advance. The University of Oxford commented on his failure to arrive at a result. The record reads: "Paid Mr. Inigo Jones, a great traveller, 50 pounds; he promised much and performed little." I sincerely hope that after you have heard my lecture you will be lenient with me.

My task is an explanation of the architectural tendencies of to-day. I will begin by saying that the best English buildings are very good indeed; the worst are horrid. The finest compare favourably with any modern buildings erected in any other country. They are English in character; they express insular conditions; and they are up-to-date. This result is due to the skill of the architects, to the educational policy of the Royal Institute of British Architects, and to the fact that school-trained men are beginning to practice.

Architecture is an aristocratic art; it demands a cultured view point. It depends for its success upon the supreme control of an artist. In spite of the psychic delirium of "Modernism," it has not been found possible to invent a formula for design. If we were a nation of robots we might be content to admire a machine-looking style. At this present we are untidy human beings, living amidst the accumulations of the past. In our simplicity we cling to human associations. Our thoughts are limited by our surroundings, rubbishy as they are. Architecture from the earliest midden times indicates a striving for the ideal, a searching for something beyond the midden heaps. When we examine the development of civilisation through the ages we find a similarity of customs down to the time when steam power was invented. Changes in building were slow. The steam engine accelerated the pace; a compromise between traditional methods and mechanical production ensued. The old crafts were forced to yield to the feverish demands of a vast population. The change was disturbing. Agriculture gave place to intensive industry. During the 19th century architecture passed through a series of revivals of period styles. Its moods reflected the opinions of the time. This experimental stage had its parallels on the Continent of Europe and in America. From the welter of conflicting opinions, current in the 19th century, has emerged respect for the masterpieces of the past.

At the present time we have two factors to consider; the first is the ordinary view point of the average English architect; the second is the effect of architectural novelty, insular and foreign, upon that view point. The craze at the moment is for originality, or "Modernism." In order to appear original, men begin inventing new names for old things (at Peacehaven there is a shop filled with articles labelled "Moderniques"). We can assume the resisting

forces to be those of efficiency on the one hand and educated taste on the other. If buildings were to be efficient and nothing else, it is conceivable that they would lack pictorial grace. Even an efficient building must have the stamp of character. Therefore, what is termed scholarship or taste should be an essential attribute. By taste is implied order, rhythm, proportion, arrangement and character expression. Those in search of a new style are often careless. There is a mistaken zeal for originality. A novel fashion comes into play, fine building is regarded as obsolete. This carelessness is one of the faults of the age. All sections of modern society mistake novelty for a fundamental truth. Democracy lacking guidance is content with substitutes; beauty and refinement such as our forbears loved have no place in modern ethics.

When mass architecture of the better sort is controlled, it rarely fails to satisfy cultured opinion. We are realising that democracy cannot state its ideals unaided. We have only to examine the riband developments on the main roads to appreciate this fact. I will say with confidence that much good architecture in this country is the outcome of unified control. In the works of public bodies, such as His Majesty's Office of Works, the London County Council, and the Ministry of Health you will acclaim the value of control. On the Kennington Estate of His Royal Highness the Prince of Wales you can see architecture called into existence by thought for the inner spirit of the people. I quote these authorities in order to emphasise my point, which is that architecture is the most aristocratic of the Arts. You know it to be the highest expression of culture, a reflection of past and current tendencies; the art of building finely. It should be above the petty annoyances of fashion, and period-style stunt novelty. It should be architectonic. You will say "this is splitting straws—an attempt to define the indefinable. Are we to regard a building as a skeleton structure conforming to some geometrical plan, and is it necessary for an architect to hang the structure with the glad rags of a culture that is obsolete?" Yes and no; this is what I do mean. Architects must be Janus-headed. My view is that an architect is in the position of a playwright. His job is to devise the scenario. Let us suppose, to take a simile, that we substitute horizontal lines for vertical ones in an elevation. We shall do this better if we are acquainted with tradition than if we scheme fantastically. Once again we return to the issue of *de gustibus*. I can quote examples of horizontal windows sixty feet long in the warehouses of the London docks built 50 years ago. There is nothing new. We have the cantilevered fronts and the bay windows of Tudor houses that anticipate the cantilevered novelties of Corbusier. We will agree that novelty of statement is possible. For example, you can strip naked, or you can don strange garments, but you cannot change physical principles. Attempts to dehumanise buildings are symptoms of fashion. Such attempts become out of date very quickly. You will remember the fate of the travesty of the Ludovisi throne.

If we were a nation of robots we should not need culture of any sort. We should have arrived, and that would be sufficient. Futurism is a form of snobbery.

This is a utilitarian age; it is also an age of survivals. The inevitable compromise between tradition and invention is in process. We have passed from copy-book architecture to an understanding of structure. Because we are underlings present-day architecture is transitory. You are not likely to change building manners by advocating the *robotesque* as a remedy for every artistic shortcoming.

I am sure you will appreciate the difficulties of architects. We are all in sympathy with new ideas but there are few who desire to sacrifice beauty to utility. Later on, when the best buildings of to-day are shown on the screen, you will see how the compromise is working.

English architecture of to-day expresses contemporary life. It can be divided into five categories:—

(a). Commercial architecture—offices, banks, warehouses, factories, transport buildings.

(b). Housing—town and country houses, cottages, farms, etc., etc

(c). Civil—post offices, town halls, schools, bridges.

(d). Religious buildings—cathedrals, churches.

The bulk of the work comes under (a). Here we find traditional materials cloaking the skeleton structure which is the real building. We have yet to devise the efficient factory, the attractive city office, the best form of garage, and the right type of bank. The bank, it is true, has gained a certain ostentatious character. Generally, the bank is a classical building bedizened with unnecessary ornament. Scholarship combined with efficient structure is the heaven required.

Housing in town and country comes next. Climatic conditions fortunately must still be observed. During the past four centuries brick has been found the most suitable material. The housing question has evolved a new cottage style for villages and garden cities. The best work of this class has charm; it is free in design, logical, economical, and typically English. The people who live in these new cottages and small houses know little about architecture, but they are content with their homes. Modern housing in towns and cities proceeds on the lines of communal dwellings and flats. The best of the latter have uniformity. The planning is reasonable, the elevations pleasant and sunny. No other country has evolved similar buildings; they satisfy the Englishman's thoughts of home and have a familiarity which is friendly and human. Such buildings represent the view point of English architects.

The civic buildings come next.

I doubt whether you will encounter better post office buildings than those erected by His Majesty's Office of Works. The planning of schools has improved, thanks to the Board of Education. In the design of bridges, England is not

behind any other country. The new Border bridge is among the modern triumphs. The new steel bridge at Newcastle-on-Tyne has all the daring of Telford's masterpieces across the Menai Straits. The new bridge in massed concrete is a thing of beauty. And so on and so forth. But the good things are overshadowed by masses of *mere building*, not fine building.

You will be astonished at the excellence of design of many new churches. True, such buildings exhibit Gothic principles, but they are otherwise up-to-date. The plan of Liverpool cathedral is original, even if the detail is mediæval. There are churches recalling Byzantine formations, and structures of plain brick, of stone, and concrete, which belong to this age and no other.

Once more I will hold the mirror up to the best of contemporary English architecture and show it to be *architectonic*. In the main it is the outcome of 19th century experiment. But there are some who say that this peculiarly English expression does not go far enough. Such critics would have English architecture more cosmopolitan in character. They would have Englishmen express themselves as Germans, Frenchmen, Americans, Dutchmen, Swedes, and a score of nationalities. It is imagined, somewhat vainly, that other countries hold the formula for architecture. Hence the English preference for foreign artists with names ending in "ski" or "stein". How pathetic it is that young Englishmen trained in the schools should be forced to seek employment away from their own country.

We will now examine the foreign influences.

Denmark.—Here the modern architecture is mainly based on tradition. It is orderly, human in scale, unostentatious, reasonable, aristocratic and direct.

Sweden.—Similar to Denmark. More adventurous, more regard for structural integrity, beautiful in detail, economic in expression. Architectonic to a degree.

Germany.—The whole country organised to capture the world's commerce. The finest factories, shops, warehouses, and railway stations. Cinemas, theatres, and dance halls of novel character. Domestic architecture generally of the old Nuremberg style, mock half timber, beetle-browed roofs, squint dormers, in this apeing "ye olde English" copy-book style. The reverse shows vast blocks of flats for the workers, strange houses of small scale, built of concrete. The robot population of Germany accepts such things without complaint. Teuton efficiency has produced new factory types. "Modernism" in Germany has made great headway. There is novelty of design in the planning of the larger buildings such as the Tietz stores, and ingenuity in the planning of factories for specific purposes.

The robotesque style has gained ground, but it does not provide a formula for all buildings. There is a tendency to design every new building to the same rulings, with the result that churches resemble factories and cottages are akin to boxes. The new style expresses industrial efficiency, but it is inhuman. Even the Germans refer to it as the marvel of engineering.

France. The French define the term "modern" as intelligent evolution from tradition. They are right. Such buildings as those designed by the Perret brothers are very good indeed. The aeroplane and liner style of Messieurs Corbusier and Mallet Stephens has gained followers. But good sense in architecture and the national regard for artistic culture preserves equilibrium.

Holland.—Here we find a definite break with tradition. A new treatment of the national brickwork combined with concrete. Novel blocks of working class houses. Very good factories. A tendency to manufacture design and to dehumanise architecture.

America.—During the 19th century America experimented with the conventional styles of Europe. The culmination came with the classical fever, which added a giant order to the upper works of skyscrapers and adapted the Baths of Caracalla to railway stations. The works of Sullivan and Frank Lloyd Wright represent attempts to give America an indigenous style. They are partly successful, but they do not stand for an universal formula.

The chief contribution of America to the world's architecture is the modern skyscraper. This type of building would not have been possible but for the use of steel for the bones of the structure. The zoning laws have produced *ziggurat* forms. The types have great beauty of silhouette. The vertical line dominates. The cultured view point of America at its best is expressed in the works of the late Charles Goodhue. This is a view point which respects tradition and, at the same time, allows scope for adventure.

Now the effect of these cosmopolitan commands upon the mentality of some architects in England is bewildering. There is little chance for steady evolution when all other countries are ruled by the demon of modernism at all costs. The illustrations of foreign buildings which reach English architects by every mail, and at the whim of every photographer, disturb the outlook. Fashion and a new sort of copyism are conjointly producing changes which are far from beneficial. From America has come the rage for skyscraper tops. From Germany has arrived the mania for bestial sculpture. Everywhere we see ill-digested versions of the robotesque. From France we have obtained the Mallet-Corbusier fashion, dictated by economy, frugality, and maturity. The Dutch bulbous style has not caught on, but we have much to learn from the Hollander in the treatment of commercial buildings. The quiet building manners of the Danes and the Swedes, analogous to the English mood of the 18th century, unfortunately are not appreciated.

Small wonder that English architecture should exhibit so many differentiations. When designed by men with knowledge of fine building the result is good. But at the hands of opportunists buildings become reminiscent of present-day continental experiment. At the call of democracy the art of building is at its worst. It has descended to the level of substitute materials such as "bungaroid."

The subject is a difficult one. We must ask this question: Is culture of the human sort to go down before the onslaught of intensive industry? What is there to be gained from the wholesale urbanisation of the countryside, the suppression of good manners and the encouragement of a factory style? Thank God we have not quite reached that stage. We are keen for architecture to be distinctive. We confess to be aware of what is going on in other countries and to be ready to profit by new ideas. But we are tired of hearing that the best English work is old-fashioned, when we know the contrary to be the case. My fear is that so-called "modernism" is another name for syncopated stunting, and as such it deserves to be suppressed.

CONCLUSION

In order to view the present disinterestedly I propose to conclude with

AN IMAGINARY PAPER

(Read in this hall *a century ahead*, in the year 2029)

FRIENDS OF THE ARTS,

The bitter invective which accompanied the development of architecture a century ago is not a little astonishing. In those days public opinion was not alive to the good buildings which were then being erected. To-day we view the best buildings of the reign of King George V in a more favourable light. In spite of the apathy of the public and the lesser municipal authorities, some English architects of 1929 had the good sense to continue time-honoured proportions. The mellowed and charming buildings which have come down to us are examples of former skill and good taste. It is owing to these masterpieces that our present method of designing has reached a high standard. When we think that a century ago architectural education was in its infancy, when we realise that the age was one of transition from period styles to a realisation of fine building, we admire the reticence of the old architects.

It was not until 1950 that the famous Act was passed which prohibited the building of bungalows and small villas on the great trunk roads. The clearance of the ruins of these crude cabins is still in hand. About this time, 1950, the municipal authorities in every large city adopted measures to ensure comprehensive designs for street architecture. Old buildings of historical character were scheduled and preserved by Government; the frightful slums were cleared, and new regulations were framed zoning the trades and factories. Old London, which during the centuries had grown from a walled city to a chaotic sprawl, was placed under the control of a central body. The old parochial and ward administration now gave place to organisation on the grand scale. London then extended for thirty miles in all directions. Legislation, however, decreed that land speculation beyond this point should cease. The new laws for the revival of agriculture came into being in 1960.

At this time electrical power was developed at the pit head and the hideous grid system of 1932 was replaced by underground *conduits*. The motor roads which were constructed between London, the ports, and the manufacturing centres in 1940 attracted the unwieldy lorries and curious motor cars from the mazes of mediæval roads, thus saving the countryside. These great avenues, since planted with fruit trees, are now the most pleasant walks in the world. You can trace their direct course when travelling from any of the airports. More instructive are the old 19th century railroads with their fine viaducts and splendid embankments. The electrically-hauled goods traffic to-day, which is confined to their monumental ways, perpetuates the memory of the canalisation of England two centuries ago. All these internal improvements have had a beneficial effect on the national architecture. We know what it is to enjoy life in town in these days. We shop in comfort at the roof level and we use the pavements as platforms to the moving ways. There is little noise. The city streets have long been closed to wheeled traffic. Life in London to-day is convenient and pleasant. The river is gay with pleasure craft from Oxford to the Nore. Since the factories were removed the smoke nuisance has vanished; rarely do we get more than a sea mist in town.

The increase in the number of dairy farms thirty miles from Charing Cross is a further sign of the national well-being. England is now largely self-supporting in food production. The curious food markets of central London were decentralised long since, and in course of time it is hoped that the new circular boulevard will create residential centres on the site of the ancient Victorian suburbs.

To-day we have commercial buildings of simple character, which are in marked contrast with the older buildings of the city. People have learnt to inspect goods within the bazaars and do their lounging on the elevated terraces. Who among the public would dream of patronising a store where all the goods were heaped in vulgar display behind a sheet of plate glass. We have reached a stage of taste which controls the external appearance of our streets. The Neo-Georgians of 1929 tried to reface London with Portland stone. We have adopted a veneer of marble for our concrete, besides inventing a surface which forms part of the concrete itself. We still employ brickwork, and shall continue to do so, but we have become more accustomed to colour buildings. The early experiments in thin concrete were found to be unsuited to this climate, as were the long, low windows which came into use about 1940. It was found that the rooms windowed thus were too cold in winter (even when electric heating was cheap). The Neo-Georgians thought themselves modern. In this age when it is criminal for any member of the community to lack good taste it is interesting to know that our ancestors were among the untidy peoples of the then civilised world. After one of their public bank holidays, the lorries used to go round collecting tons of waste paper from the parks. London life was very different then. We have indeed advanced. People are healthier

to-day and live to a ripe old age. England can house and feed her fifty millions with ease. The emigration of whole districts to Canada, Australia, and South Africa in 1970 was one of the wisest moves of that period. Looking back on the year 1929, the close of the first post-great war period, we discern the beginning of the movement which raised democracy to an appreciation of the spiritual side of existence. Nothing dies, there is only change. We have no desire to probe the mysteries of the inscrutable future, but we know most certainly that in due course the order which has come about will be improved and that generations yet unborn will look back upon this epoch of 2029 as we view the buried past.

DISCUSSION.

THE CHAIRMAN said he was accustomed to listen at the Royal Society of Arts to first class lectures, but he thought he had never had his eyes and his ears simultaneously charmed more than that evening. To hear Professor Richardson speak well of the present was in itself refreshing, but to hear him, with the full knowledge of history behind him, speak well of the younger generation and therefore of the future was even more satisfactory. He (the speaker) had lived in England in the late Victorian period, and, returning here after an absence of nearly a quarter of a century, he had seen a very extraordinary contrast between the past and the present. They must take off their hats to the past and their coats to the future. Professor Richardson had shown how they were taking off their coats to the future, and he (the speaker) thought that every political party in the country should have come to the lecture to be encouraged for the future by looking at what had already been accomplished. There were many persons present who were in a position to add something to what Professor Richardson had said, and he hoped there would be a most free discussion.

PROFESSOR STANLEY ADSHAD (Professor of Town Planning, University of London) said that when he heard that his old friend Professor Richardson was going to lecture on such a great subject to so distinguished an audience he felt that he should attend, and he had been very anxious to hear those very piquant remarks which he thought would be forthcoming. He congratulated the lecturer that night upon his extraordinary reticence. The lecture had been so tremendously full that it was very difficult on the spur of the moment to say anything about it which would do justice even to some of the less important observations the lecturer had made, but in thinking over the lecture, he felt that perhaps Professor Richardson was at his best when he emphasised how the architecture of 1929 would look in the year 2029. With regard to the general comments that had been made, the lecturer had stated that the success of architecture depended not upon what was put on but upon what was taken off. There was a very great deal of truth in that, but he thought that in the latter part of the 19th century a certain reserved feeling had been manifested by some of our architects, which amounted to the removal of all plumage whatsoever. One of the most prominent features of architecture was that it had a human side, and perhaps the best thing Professor Richardson had said was that architecture was no good unless it was human, and that the tendency of a great deal of modern architecture was to become machine-like or robotesque, very human, but very impersonal. The whole essence of

architecture was to be human, and if it expressed the best kind of humanity then it would be the best kind of architecture.

MR. JOHN HODGSON thought the most important feature of the lecture was that architecture was aristocratic and must be controlled. In all the great ages of architecture it had either been temple architecture or church architecture, and there had been a small group of people controlling a tradition and then gradually developing it. Then when the Victorian Age arrived, when a mass of uncultured people became rich and were able to control architects, all kinds of things occurred. He thought they were getting out of that state now and that a period had been reached when architecture, which had lost its culture, was beginning again to get under proper control. If everybody who ordered a building was able to say exactly what kind of building they wanted, naturally indiscriminate planning and ornament were obtained everywhere. The lecture had been amazing. As one travelled about the country, seeing the different buildings depicted on the slides, one felt that it was a wonderful country to live in. He would like to have a list of Professor Richardson's slides so that he could go round the country and see actually how beautiful it was. The developments in England were quite up to those in Sweden, Germany or Denmark, and, what was more, the structures were built according to English tradition. There had been the criticism by Professor Richardson in respect of "funnies," which he thought he would like to see done away with. Of course, all decoration in architecture was put there for the sake of association. There was the simplest form of decoration, first of all the basket mark in pottery before the invention of the wheel for moulding. When primitive man made pottery one got the impression of basket work with it. When the wheel was invented for making pottery, it was still felt that pottery should have the basket-work appearance on the outside, and so man decorated his pottery with the old basket-work impression he had become accustomed to see. The same thing was seen in the great concrete buildings around London, there were the lines in the stones, because we had got used to looking at that sort of thing. There were other instances, the early English carvings in the cathedrals, and the festive ornaments on the stone, which represented what were originally decorations for special days, but became a permanent thing in every building. Then when a new industrial age arrived, the people did not understand the tradition that had grown up, and they naturally had to clear the way and build a new tradition of their own. He thought that stage had now arrived. Much of the tradition of the past was not understood, and the classical architecture of the Greeks and of those who carried on the Greek tradition, was not thought so much of, but they were buildings of simplicity and grace of form. He was thoroughly in agreement with Professor Richardson that ornament should not be put on buildings which was not part of the design. He was extraordinarily pleased with the lecture which Professor Richardson had given.

MR. GODFREY GILES, P.I.B.D., said that after such an admirable lecture he could not help feeling that some of the oldest of the audience must have learned a great deal. Professor Richardson had shown pictures of buildings which were absolutely plain. He (the speaker) was not an architect, and possibly, therefore, he was one of those who could not quite appreciate Professor Richardson to the uttermost. He noticed in one of the pictures that one of the buildings had no cornices. There might be a certain dignity in such utter simplicity, but he thought that some beauty also was lost in having a building which was like a match-box in design. In London two very distinct types of buildings had recently been erected. There was one

block of buildings in Park Lane, with funny little things on the top, otherwise the block was quite square. He noticed only that day that some columns were being erected, so that possibly it might be all right when it was finished. Then there was Regent Street as it was to-day. Probably Professor Richardson would contend that Regent Street was too ornate, but, personally, he thought that Regent Street was very fine, and that if the block of buildings in Park Lane to which he had referred had a little more of the Regent Street touch, and was a little more classical, it would be an improvement. He was very grateful to Professor Richardson for his excellent lecture.

THE CHAIRMAN said he had never with greater pleasure heard anybody speak on the subject of architecture. There had been no gratuitous praise of foreign buildings, which was particularly pleasing. Dr. Johnson defined prejudice as "belief which has survived its original justification," and a great many prejudices had to be faced in this country in regard to architecture as in other matters. A good deal had been heard as to objections to ornamentation, "funnies," etc., but he could not help feeling that ornamentation of buildings was largely a matter of taste, as, for example, in the question of moustaches and beards. This depended on the country and the period in which one lived. He was recently studying architecture of the period 4,000 B.C., and found it did not err on the side of simplicity. There were great masses of brick, and in high relief thrown out from the brick were, not gilded but golden bulls, fifty in a row. He was not without hope that that sort of thing might reappear. Professor Richardson had not referred to the difference in national architecture caused by the amount of shade that might reasonably be expected during the year. He had noticed, for example, that in Central America, under the Equator, buildings tended to take quite a different shape and form owing to the fact that shade was practically absent at noon. As for the people who were supposed to lay down precisely what kind of buildings they required, he had had some experience of architects, and he could assure the meeting that the public did not get away with it quite so easily. One might tell an architect what sort of building was required, but that was only the beginning of the battle, and in the long run it was the architect who built the house. It was well that that should be so, because it was worth a good deal to live in a good house. Mr. Richardson mentioned that in 2029 they would be beginning to clear away the "rubbish" (the bungalows) built along the roads, but he was doubtful whether those buildings would last so long, as the work was so inferior in many cases. In his opinion, they would not last until 1969, and no compensation need be paid for them being cleared away. He had lived most of his life in tropical countries, and he could not help thinking that they were making too much of a fetish of sunlight just now. He believed that our 16th century ancestors, before the window tax ever came in, had very good reasons for wishing to keep the sunlight out. Sunlight in a house was a source of considerable irritation if shining on one direct, and people who were healthy and who were living an out-door life did not sit in the sun for choice. He thought that the modern fad for sunlight in the house would probably go, like other fads. What was required was light. He would conclude by reminding the audience that, although the present lecture was a very exceptional one, week by week excellent lectures could be heard at the Royal Society of Arts on a variety of topics, dealt with by persons as well qualified to deal with their respective subjects as Professor Richardson was qualified to deal with his subject. He suggested that those present who were not members of the Royal Society of Arts should become enrolled as such. Membership of the Royal Society of Arts was not a claim to expert knowledge or scientific proficiency ;

it was a distinguished fellowship designed to encourage the arts, science and commerce of this country. It was a fellowship of desire rather than of accomplishment, and he knew of no society in London which could inform its members so well or so regularly upon every topic of current importance as the Royal Society of Arts. It was not everyone that could attend a weekly lecture in London, but those who were living in London would find themselves very amply rewarded. He asked them all to extend to Professor Richardson their hearty thanks for an exceedingly valuable lecture which must have taken him a very great deal of time and trouble to prepare

The resolution of thanks was carried unanimously.

PROFESSOR RICHARDSON, in reply, said his object in showing the slides was to give the sum total of the best current work of the post-war period, which personally he liked. There might be more advanced things, but that work was a very fair sample of what was going on, and if the general level could only be raised to that extent there would be no cause for complaint. He thanked them all for listening to him so attentively.

The meeting then terminated

OBITUARY.

— ♦ —

ROBERT SKELTON. — Mr Robert Skelton, who died on April 27th, at his home at Harrow, spent nearly the whole of his working life as engineer to the Municipality of Colombo, Ceylon. Born in London in 1863, he received his technical education at King's College, London, and on passing out "with high distinction," he was articled in 1884 to his teacher, Professor Henry Robinson, M.Inst.C.E., who, on the completion of his articles, in 1886, retained him as his assistant. During the following two years Skelton was employed in carrying out surveys and drawings for a number of waterworks and sewerage disposal schemes, until in 1888 he was appointed an assistant engineer in the Ceylon Public Works Department. Soon after his arrival in Ceylon he became Municipal Engineer at Colombo, and during his tenure of this office extending over nearly thirty years he was responsible for a number of important improvements, including the formation of a City Sanitation Department and a Waterworks Department. He was also keenly interested in town-planning and road construction, and one of the great thoroughfares which he planned was named by the City Council "Skelton Road," in recognition of his services. After his retirement in 1915 he took a considerable interest in Egyptology. Mr. Skelton was elected an associate member of the Institution of Civil Engineers in 1888, and became a member of the Institution of Municipal and County Engineers in 1895. He had been a Fellow of the Royal Society of Arts since 1903.

INTERNATIONAL EXHIBITION OF COMMERCIAL ARCHITECTURE

INTERNATIONAL EXHIBITION OF MODERN COMMERCIAL ARCHITECTURE, R.I.B.A. GALLERIES 9, CONDUIT STREET, LONDON. — "Ferro-concrete," says Mr. Goodhart-Rendel at the end of his preface to the catalogue of this exhibition, "is no longer new or exciting, it is part of our daily lives. . . . Indeed, a large number of

people may further have discovered that a very useful kind of concrete, not actually ferro-concrete, but a medium of tremendous strength, was extensively used by the Romans. A superficial knowledge of the Wonders of the Ancient World soon cures the tendency to overrate the wrong, *i.e.*, the purely technical, elements of modern building. We have more money than the Ancients, but they had more time and more labour at their disposal, and the hugest skyscraper has not more impressive proportions than an Assyrian ziggurat or the pyramids of Gizeh.

The skyscrapers do not come very well out of the present ordeal of comparison with European architecture. In general, they have in common with certain Gothic churches a naturalistic quality, a suggestion about them that they grew up out of human control. Some people like this quality: they will like the skyscrapers. And in fact the application of classical features to these disproportionately tall houses is apt to be a complete failure. An illustration of this is afforded by Eric Mendelsohn's photograph (in his book, "America") of the portico of the Federal Reserve Bank Chicago. As the author dryly comments: "Greece as beast-of-burden (*lastest*) of steel construction." Even so, the Ionic Order is like a blessed glimpse of an oasis in this desert of walls and windows.

The less lofty American buildings shown are not particularly attractive; No. 38, a Chicago warehouse, could hardly be more depressing, combining, as it does, the gloomy characteristics of a medieval dungeon erected for the utilitarian purposes of war and a nineteenth century factory or lunatic asylum. But before reaching 38 we have already observed that modern warehouses can be simple and fine: the point is proved by 30, warehouse at Basle, Switzerland. And our spirits have also been raised by 36, Eric Mendelsohn's hat factory at Luckenwalde, Germany. The Einstein Tower may be the best known, but it is no doubt far from being the best work of this very talented architect.

The hat factory is wholly original, and it is as plainly a deliberate human creation as the skyscrapers are the outcome, largely, of circumstantial pressure. No. 41, factory, Paris (interior), is a gaunt, apparently concrete, building, not merely saved from banality, but made really interesting by a stroke, one might say, of genius. The great circular arches give æsthetic unity to the room and infuse the whole space with life and rhythm.

Neither Dr. Van Heukelow's Railway Offices, Utrecht, Holland, 51, nor the office building, Lubeck, Germany, 50, are any the less forcefully modern for their embodiment of traditional elements. In the former we see Gothic repetitions without Gothic spikes and frills, in the latter, the outlines of a typical German Rathaus. In both cases brick is used with admirable effect. At last, with 97, Courtauld's new premises, London, we come to an English building that we can admire. The treatment of the square columns which are the chief feature, is masterly; they might well have become unmanageable, but with a roof of sufficient weight and a fine doorway they make a strong combination.

In architecture, as in other respects, the French second class is better than the second class of other peoples. The shop front in the Faubourg St. Honoré, No. 109, is not first rate, but it is very good. Altogether, the French deserve great credit for leading the revolt against those expanses of glass in the ground floors of shopping streets, which have had such a devastating effect on urban architecture. Bourne and Hollingsworth's in Oxford Street is a classical example of the abuse; Paris Trades in Berkeley Street an example of the reaction. At least, if there is going to be a good deal of glass, let the superstructure be light and airy, as the eminent French architect, Rob. Mallet-Stevens, can make it.

Holzmeister's Festival Theatre at Salzburg, Austria, 148, is beautifully unostentatious and reserved, while Poelzig's Capitol Theatre in Berlin is beautifully

luscious and dazzling: somehow like a brass band or a shower of stars from a gigantic rocket. (157, interior.) Here the fireworks are so well organised that they thrill and do not offend: there is a difference between Santa Maria della Salute and the mouldings on the ceiling of a late Victorian drawing-room.

Professor Tengbom's Concert House, Stockholm (172-3-4) is a very successful adaptation of the classical. The portico is magnificent. The Corinthian capitals are not too ornate, and the columns are given a modern feeling by being cut into facets and having the joints of the masonry well marked. At the opposite pole of derivative work are the flats in the Paseo de Gracia, Barcelona, No. 235, which, however, it is difficult to judge from a single photograph. No. 238 shows some flats on the Larkhall Estate at Clapham, built by two architects with foreign names, but in a style that is well suited to the environs of London: very different from the grottoesque, or truly grotesque, of the Paseo de Gracia.

Is there a good deal to be said for the Stuttgart Railway Station of Paul Bonatz? The masses are excellent: but is there not perhaps something uncivil about the texture of the surfaces? In itself the station is imposing and agreeable, the question is, does it harmonise with its surroundings, or, let us say, with the best probable surroundings that it is likely to get in a central European town?

Included in the exhibition is a big model of the new Underground building at the end of Tothill Street. The plan is a worthy, if not actually a very pleasing one, and the building will deserve the name of architecture. It is perhaps too big to be altogether humanly congenial, but is not too lanky nor too over-developed in any of its members. On our round globe and with our round heads we seem to have some deep seated prejudice in favour of domes rather than of flat topped towers: there is a touch of the primitive or the barbaric about these, a suggestion of Polyphemus with his solitary eye.

A most interesting and most useful exhibition. Everyone should go.

NOTES ON BOOKS.

THE THEORY OF FILM LUBRICATION. By R. O. Boswell, B.Sc. (Eng.) Lond., M.Sc. (Tech.) Manchester; Lecturer in Mechanical Engineering in the College of Technology and in the University, Manchester. London, Longmans, Green & Co., Ltd. 12s. 6d.

The term "film lubrication" of bearing surfaces implies the maintenance of a continuous film of lubricant between the surfaces in question, which are thus definitely preserved from mutual contact. From the point of view of reduction of both friction and wear it is highly desirable that this condition should be fulfilled in all machinery; and a gradually increasing sense of its importance is to be noted in modern bearing-design. The foundations of the subject were laid by certain observations made in 1883 by Beauchamp Towers, leading to a general theoretical treatment by Osborne Reynolds in 1886.

The essential observation was to the effect that, when proper measures were taken to supply unlimited oil in the right places, the lubricant at the bearing surface of an ordinary journal was sustaining a heavy hydrostatic pressure. This pressure, which was measured by the simple device of boring a hole right through the bearing to the journal at any desired spot and inserting a pressure-gauge, was found to vary from spot to spot, falling to atmospheric value all round the edges; but when the various local values were integrated over the whole area, the sum

was found to be almost exactly equal to the total load on the bearing. It was therefore evident that the entire pressure was in fact being borne by the oil-film, no direct metallic contact occurring between bearing and journal; and it was further observed that, when this desirable state of affairs was set up, the frictional resistance fell to a small fraction of its (variable) value under the normal conditions of limited oil-supply by syphon or pad.

The subsequent mathematical investigation by Reynolds, in which it was assumed that the ordinary conditions of viscous flow were applicable to the oil-film in the bearing, has been greatly extended in subsequent years, but until now no textbook has appeared to collect and criticize the results. Mr. Boswall, by assembling his own researches and those of others in this field, has performed a notable service to all those interested in the subject of lubrication.

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

MONDAY, MAY 27. Architects, Royal Institute of British, 9, Conduit Street, W. Mr. H. Percy Adams, "English Hospital Planning," at the Aeolian Hall, New Bond Street, W. 8.30 p.m. Mr. L. J. Roblins, "A Journey in Central Siam."

Surveyors' Institution, at 12 Great George Street, Westminster, S.W. 5 p.m. Annual General Meeting University of London, at King's College, Strand, W.C. 5.30 p.m. Rev. G. Galloway, "Religion and the Transcendent" (Lecture I)

At the London School of Economics, Houghton Street, W.C. 5.30 p.m. "Some Modern Philosophies of History" (Lecture IV). Prof. Dr. A. F. Pollard, "History and Philosophy."

Victoria Institute, at the Central Hall, Westminster, S.W. 4.30 p.m. Sir W. M. Flinders Petrie, "Materialization of Old Testament History."

TUESDAY, MAY 28. Anthropological Institute, 52, Upper Bedford Place, W.C. 8.30 p.m. Mrs. M. Hasluck, "Turkish Games."

Statistical Society, at the Royal Society of Arts, Adelphi, W.C. 5.15 p.m. Mr. A. Loveday, "The Measurement of Tariff Levels."

University of London, at Birkbeck College, Bream's Buildings, E.C. 5.30 p.m. Prof. Sten de Geer, "Sweden and the North of Europe" (Lecture II).

At King's College, Strand, W.C. 5.30 p.m. Prof. Anathon Aall, "The Hellenistic Element in Christianity" (Lecture III).

5.30 p.m. Sir Bernard Pares, "Contemporary Russia" (Lecture V).

At the London School of Economics, Houghton Street, W.C. 5 p.m. Prof. Luigi Einaudi, "Taxation" (Lecture I).

At University College, Gower Street, W.C. 5.30 p.m. Prof. A. Brachet, "Experimental Embryology" (Lecture I).

5.30 p.m. Mr. Robin Flower, "Life, History and Folklore of a Kerry Island" (Lecture II).

Zoological Society, Regents Park, N.W. Scientific Business Meeting, 5.30 p.m.

WEDNESDAY, MAY 29. Eugenics Society, at Burlington House, W. 8.30 p.m. Mr. E. B. Ford, "Recent Work on the Physiology of Genetics and its Bearing on Human Problems."

Geological Society, Burlington House, W. 4.30 p.m. University of London, at King's College, Strand, W.C. 5.30 p.m. Rev. G. Galloway, "Religion and the Transcendent" (Lecture II)

5.30 p.m. Colonel C. N. F. Broad, "Modern Wars with Ancient Tasks: a Study of Mechanisation."

At the London School of Economics, Houghton Street, W.C. 5 p.m. Prof. Luigi Einaudi, "Taxation" (Lecture II).

5 p.m. Dr. Hubert Hall, "The Nature, Value and Uses of English Judicial Records as Sources of Economic and Social Information." (Lecture V).

At University College, Gower Street, W.C. 5.30 p.m. Prof. A. Brachet, "Experimental Embryology" (Lecture II).

5.30 p.m. Prof. E. D. Wiersma, "The Psychology of Dementia." (Lecture I).

THURSDAY, MAY 30. Birth Control and Racial Progress, Society for, at Essex Hall, Essex Street, W.C. 8 p.m. Dr. Mather Thomson, "Sterilization of the Unfit."

Chadwick Public Lecture, at the Chelsea Physic Garden, Swan Walk, S.W. 5 p.m. Mr. H. V. Taylor, "Supplies from the Vegetable Kingdom and the Public Health."

Chemical Society, at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W. 5.30 p.m. Prof. W. H. Perkin, F.R.S., "The Early History of the Synthesis of Closed Carbon Chains" (Piedler Lecture).

University of London, at Birkbeck College, Bream's Buildings, E.C. 5.30 p.m. Prof. Sten de Geer, "Sweden and the North of Europe" (Lecture III).

At King's College, Strand, W.C. 5.30 p.m. H. J. Evers, "Agrarian Reform in the Danubian Countries" (Lecture V).

5.30 p.m. Prof. P. Karrer, "Organic Chemistry" (Lecture I).

At the London School of Economics, Houghton Street, W.C. 5 p.m. Prof. A. Aall, "The Psychology of the Individual and of the Mass." (Lecture I).

At St. Thomas's Hospital, Albert Embankment, S.E. 5 p.m. Prof. S. J. Cowell, "Dietetics" (Lecture V).

At University College, Gower Street, W.C. 5.30 p.m. Prof. E. D. Wiersma, "The Psychology of Dementia" (Lecture II).

FRIDAY, MAY 31. University of London, at King's College, Strand, W.C. 5.30 p.m. Rev. G. Galloway, "Religion and the Transcendent." (Lecture III).

5.30 p.m. Dr. Otakar Odhruilik, "Good King Wenceslas: an Historical Sketch."

At the London School of Economics, Houghton Street, W.C. 5 p.m. Prof. A. Aall, "The Psychology of the Individual and of the Mass." (Lecture II).

At University College, Gower Street, W.C. 5.30 p.m. Prof. A. Brachet, "Experimental Embryology" (Lecture III).

5.30 p.m. A Lecture on the Recent Discoveries of the British School of Archaeology in Egypt at Beth-el-eth Palestine, by Prof. Sir Flinders Petrie.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 3993.

VOL. LXXVII.

FRIDAY, MAY 31st, 1929.

*All communications for the Society should be addressed to the Secretary, John Street,
Adelphi, W.C. (2.)*

NOTICE.

COUNCIL.

A meeting of the Council was held on Monday, May 13th. Present :-- Sir George Sutton, Bt., in the Chair ; Sir Charles H. Armstrong ; Lord Askwith, K.C.B., K.C., D.C.L. ; Sir Charles Stuart Bayley, G.C.I.E., K.C.S.I. ; Captain Sir Arthur Clarke, K.B.E. ; Mr. Peter MacIntyre Evans, M.A., LL.D. ; Sir Edward Gait, K.C.S.I., C.I.E. ; Rear-Admiral James de Courcy Hamilton, M.V.O. ; Sir Herbert Jackson, K.B.E., F.R.S. ; Major Sir Humphrey Leggett, R.E., D.S.O. ; Sir Philip Magnus, Bt. ; Sir Reginald A. Mant, K.C.I.E., C.S.I. ; Mr. Alan A. Campbell Swinton, F.R.S. ; Mr. Carmichael Thomas, Professor John Millar Thomson, LL.D., F.R.S. ; Sir Frank Warner, K.B.E., and Sir Alfred Yarrow, Bt., F.R.S., with Mr. G. K. Menzies, M.A. (Secretary), and Mr. W. Perry, B.A. (Assistant-Secretary)

The following candidates were duly elected Fellows of the Society :--

Aisbett, John Carnegie, Melbourne, Australia

Batt, Edwin G., London.

Brown, Harold George, A.M.I.E.E., Bakewell, Derbyshire.

Butler, Alan Samuel, London.

Bvard, Miss Betty A. M., LL.A., London

Child, Nicholas Gilbert Louis, B.A., Aston Turrol, Berks

Chumley, Alick, Hove, Sussex.

Davies, James F., Sutton Coldfield.

de Kazarine, Serge, London.

Dixon, Charles William, Grimsby

Duff, Alderman James A., J.P., Belfast

Duff, Reginald James, J.P., Bombay, India.
 Elton, Charles John, Merstham, Surrey.
 Erulkar, David S., London.
 Fothergill, John Rowland, Thame, Oxon.
 Gardiner, Sir Frederick C., K.B.E., LL.D., D.L., J.P., Glasgow.
 Hall, Ernest Byfield, Market Drayton, Salop.
 Heide, Henry Conrad, London.
 Hirachand, Walchand, Bombay, India.
 Hollick, Thomas Drake, Sheering, Essex.
 Hooper, Cecil H., Wye, Kent.
 Hooper, Professor William James, Battle Creek, Michigan, U.S.A.
 Hudson, Arthur William, London.
 Hughes, Walter Martin, J.P., Bilston, Staffs.
 Iliffe, William Coker, London.
 Insull, Martin J., Chicago, Ill., U.S.A.
 Jamieson, William, Powell River, British Columbia.
 Kapur, Diwan Ram Chand, Benares City, India.
 Neate, Rayner Maurice, M.A., LL.M., London.
 Nicol, E. W. L., Assoc.I.C.E., A.M.I.E.E., London.
 Nicoll, Miss Bertha, London.
 Parker, George Vernon, Reading, Berks.
 Perera, Wilnot A., Horana, Ceylon.
 Prosser, William Richard, Bangalore, India.
 Rajamannar, T., Madras, India.
 Reid, David, Coatbridge.
 Rolls, Colin, London.
 Somerville, William Lyon, A.R.C.A., Toronto, Canada.
 Stewart, Andrew, Angus, Bengal, India.
 Telford, John Charles, O.B.E., M.Inst.C.E., Pedmore, Worcs.
 Umney, Ernest Albert, London.

The question of the award of the Society's Albert Medal for 1929 was further considered, and names were selected for submission to H.R.H. the President.

The preparation of the balloting list for the new Council was completed.

Sir Philip Magnus was re-elected Chairman of the Examinations Committee.

It was reported that the number of entries for the May examinations was 53,576, an increase of 1,820 as compared with the total for 1928.

It was reported that the conditions of sale of West Wycombe had been duly signed on behalf of the Council by Sir George Sutton, Chairman of the Council, and Mr. P. Morley Horder, Chairman of the Executive Committee of the Fund for the Preservation of Ancient Cottages, and that one-quarter of the purchase price had been paid.

The thanks of the Council were accorded to Mr. James H. Hyde for a further contribution of £500 to the Fund for the Preservation of Ancient Cottages. Mr Hyde has now contributed £2,025 to the Fund.

A committee was appointed for the purpose of adjudicating the award of the Society's silver medals for papers read during the session 1928-29.

The arrangements for the next session, 1929-30, were considered.

A quantity of financial and formal business was transacted.

PROCEEDINGS OF THE SOCIETY.

DOMINIONS AND COLONIES SECTION.

TUESDAY, 26TH MARCH, 1929.

PROFESSOR J. G. LAWN, C.B.E., A.R.S.M. (Vice-President of the Institution of Mining and Metallurgy), in the Chair.

THE CHAIRMAN said it gave him the greatest pleasure to preside, firstly because the lecture was by his old friend Mr. Warrington Smyth, and secondly because it was under the auspices of the Royal Society of Arts. Mr. Warrington Smyth had a heritage of mining knowledge: his father, as those of the older generation of mining engineers would remember, had been the Professor of Mining at the Royal School of Mines from its inception for a very long period. Mr. Warrington Smyth himself had been associated with mining during his professional life. Although not a professional mining engineer he had been Secretary of Mines both in Siam and for some 25 years in South Africa and therefore he knew a great deal about the subject. The association with the Royal Society of Arts was rather more remote. He (the Chairman) had not had the pleasure of studying under Sir Warrington Smyth, because Sir Warrington had died while he was a student, but Sir Warrington's successor had been Sir Clement le Neve Foster, whose father, Mr. Peter le Neve Foster, had worked for many years as Secretary of the Royal Society of Arts, doing so much to build it up and to put it into that position for useful work which it occupied to day. Therefore, in regard to both those connections, he was very glad to be present.

The following lecture was then delivered:

THE BASE METAL AND MINERAL RESOURCES OF SOUTH AFRICA.

By H. WARRINGTON SMYTH, C.M.G., M.A., F.G.S.,

late Secretary for Mines and Industries for the Union of South Africa.

The following notes have been compiled with a view to bringing into concise form a summary for the special benefit of those who may be visiting South Africa with the British Association during the present year.

The mineral laws of the Union make a clear distinction between precious metals (which include gold, silver and platinum), diamonds, which are legislated for separately, and other so called "base" metals and minerals.

In regard to precious metals, the legislature in all the Provinces (with certain exceptions in Natal), has reserved special rights to the Crown which strictly limit the rights of the owner of the land, who otherwise holds the mineral rights, and gives the State a very large interest in the production. With these minerals and with diamonds I am not dealing in this paper.

In regard to diamonds, again, a whole series of enactments has been passed, both by the separate Provinces and the Union, reserving rights to the Crown and to the public against the owner of the land and of the mineral rights and also providing special regulations with regard to the diamond trade.

As regards, however, the remaining groups of metals and minerals, the rights of the owner who holds the mineral rights have been left intact, and, except where there may be a special reservation, the owner is entitled to deal with his minerals as he thinks fit. He may alienate them or he may work them, subject of course, to the usual Government Regulations with regard to safety of underground working, etc.

A great deal has been written about the base metals and minerals of the Union of South Africa. The number of sources of information dealing with this subject makes it somewhat difficult for the ordinary person to find at once all the information he wants with regard to the "every day" minerals of the Union, and the object of this paper is to assist the enquirer in finding the sources from which information can be obtained and to summarize existing data. The whole subject is dealt with at greater length in the Union Government's Year Books, Geological Survey Reports, the Mines Department's Reports, and the pages of the Journal of Industries, in admirable papers written by my old colleagues, Rogers, Kynaston, Du Toit, Mellor, Hall, Wagner, of the Geological Survey, and, on the technical inspection of mines side, Swinburne, Trevor, Fergusson, Steart, Vaughan, Hutton, Jourdan, Bottomley, and I must not omit to mention my old friend Kotze, the late Government Mining Engineer. No country, I venture to say, has ever had a finer body of scientific and technical men in its employ. I should refer the inquirer to the very excellent Bibliography given in pp. 203-212 of the Chapter by Major Tudor Trevor, A.R.S.M., late Inspector of Mines, South Africa, on the Mineral Wealth of the Union in a publication of the Department of Mines and Industries entitled "Industrial Development in South Africa," published by the Government Printing Works. The Chapter in question provides the best summary to be had on the minerals of the country.

TABLE 1* COAL PRODUCTION UNION OF SOUTH AFRICA

YEAR.	TRANSVAAL.		ORANGE FREE STATE.		NATAL.		UNION OF SOUTH AFRICA.	
	Tons Sold.	Tons Sold.	Tons Sold.	Tons Sold.	Tons Sold.	Tons Sold.	Value at Pit's Mouth.	
1915	5,202,805	40,850	727,553	2,304,116	8,281,324	2,142,479		£
1916	6,136,913	41,752	762,576	3,066,261	10,007,502	2,739,665		
1917	6,641,220	8,300	843,095	2,890,206	10,382,920	3,275,608		
1918	6,438,961	4,654	826,577	2,607,133	9,877,325	3,224,597		
1919	6,622,313	4,759	838,050	2,801,004	10,266,135	3,416,244		
1920	7,180,124	5,700	966,034	3,321,606	11,473,464	4,519,665		
1921	6,947,362	5,778	917,776	3,525,989	11,396,995	5,072,401		
1922	5,380,204	6,813	729,113	3,618,093	9,734,313	3,395,170		
1923	6,742,286	6,350	865,496	4,302,862	11,917,036	3,713,706		
1924	6,790,680	5,329	982,506	4,713,291	12,491,995	3,824,740		
1925	7,397,395	5,608	974,324	4,622,339	12,999,666	3,862,118		
1926	7,593,468	5,201	976,245	5,159,549	13,734,463	4,046,620		
1927	7,495,610	4,430	1,039,995	4,852,826	13,392,730	3,825,664		
1928	7,669,374	5,059	1,088,109	4,641,365	13,403,907	3,697,611		

* The values at the pit's mouth were as follows:—Transvaal, from 4s. 4d. to 6s. 7.32d.; Cape, 11s. 4.22d. to 15s. 9.12d.; Natal, 6s. 9.50d. to 10s. 7.41d.; the period of greatest cost being from 1919 to 1921

COAL. (Table I.)

Next to the gold mining and diamond industries of South Africa, the most important mineral production has been, and is likely to be, that of coal. It is certain that the gold mining industry of the Witwatersrand could never have progressed as it has done, without the cheap and efficient coal which has been available from almost the earliest years, to assist the mechanical side of its production. To-day, a large proportion of the power requirements of the Rand is supplied by electric power companies, but the very existence of these companies depends on the cheap coal which is available close at hand.

The coal measures lie in what is called the Middle Ecca sand stones of the Karroo System. The area is so large that it is not possible to make an accurate estimate of the actual resources of the country in coal. A good deal of work on this point has been done by the Geological Survey, and especially by my old friend, Mr. W. J. Wybergh, who was my first chief in South Africa under Lord Milner, and who has given much time, ability and industry to the work of tracing the line of coal deposits and estimating the coal resources of the Union under the aegis of the Geological Survey.

The first real discovery of coal was that recorded by Dunn and North in 1878, in the Stormberg beds of the Cape Province (then Cape Colony). A second-rate coal has been produced from this area for some years, but at a high cost; and, unfortunately, no valuable coal of decent quality or extent has ever been discovered in the Cape Province, nor, I fear, is likely to be found.

COAL IN NATAL

Natal, speaking generally, is better known for its coal than any other Province owing to the fact that the coalfield is situated within a moderate haulage distance of the Port of Natal, and that a considerable export and bunker trade has grown up at that Port, which has made Durban one of the important harbours of call in the southern hemisphere.

Natal collieries are situated in the areas of Klip River, Dundee, Newcastle, Utrecht, Paulpietersburg and Vryheid, over an area of some 2,000 square miles. There are 29 producing collieries all situated within an average distance of about 240 miles of the Port of Durban.

Coal has also been found in Zululand, but it is apparently of a rather dirty and anthracitic character. Further discoveries, however, may take place in this district.

From time to time, questions have been raised as regards the quality of certain Natal coals exported or bunkered, and in 1923 a Commission was appointed by the Government of Mauritius to make enquiries regarding certain supplies of coal to the Mauritius Railway alleged to be from Natal, upon the character of which unfavourable comments had been made.

Generally speaking, Natal coals are of good quality and the following are analyses of typical Natal coals:—

ANALYSES OF NATAL COALS.*

Name of Colliery.	Moisture	Volatile Matter.	Fixed Carbon.	Ash.	Calorific Value as per Mahler Bomb Process.	Sulphur
Dundee Coal Company (Burnside) ...	0.56	23.74	68.40	7.30	15.05	1.48
Natal Navigation ...	0.90	21.78	69.91	7.41	14 to 15.15	1.30
Durban Navigation ...	1.40	30.40	58.50	9.70	13.80	0.94
Northern Navigation ...	2.00	25.30	64.50	8.20	14 to 14.50	0.83
Holbanc ...	1.50	19.30	68.30	10.90	13.84	0.96
Enyati ...	1.70	22.20	67.80	8.30	14.40	0.84
Tendega ...	1.20	21.70	69.10	8.00	14.23	0.75
Wallsend ...	1.25	20.75	66.60	11.40	13.84	—

* Report of Coal Commission, 1921.

My Department took steps to clear the character of the Natal coal by referring the matter to the Natal Coal Owners' Society, and to the Technical Officers of the Department. The result was that it was found that in 1920/21, the time when the coal was exported, there was an abnormal demand combined with a truck shortage on the railways, and the dealer took the coal without stipulation as to quality, of a class not usually supplied for shipment, but which is usually used for household purposes.

It is, one would think, fairly apparent that, wherever you may try the experiment, to purchase household coal, and then sell it for raising steam on sea-going ships, is a sure way of causing disappointment and even some unnecessary bad language in the Merchant Marine. It must be a trifle unfair and very misleading to attempt to judge the standard of production of any coal-field by such a method.

As the analysis shows, Natal coal, while admittedly not equal to the best Welsh, is comparable with English North country coals having a calorific value from 13.80 to 15.15. It is used regularly by such steamship lines as the White Star, Blue Funnel, P and O, and Union Castle, and the general opinion at sea is that it is a good steaming coal.

The stress of competition has long compelled Natal Collieries to exercise the greatest care in sorting and screening, and the Union Government has lately passed an Act under which no coal can be exported or sold unless accompanied by a certificate guaranteeing the grade of the coal, which is fixed by a Grading Committee on which a representative of the Government Department of Mines sits, or is Chairman.

Figures of production are given in Table I.

Natal Collieries, as a rule, have a considerable amount of gas, and in the history of the coalfield some very serious explosions have occurred from time to time. The fact that the seams are known to be fiery and that fire is a constant source of anxiety has induced a careful system of working both by managements and men, and experienced colliers, generally from England, are employed in every mine as supervisors of the native and Indian labour force.

The coalfield is intersected by a number of basaltic dykes which have imprisoned the gas in a series of large gastight compartments, so to speak, and the overlaying of the seams, in some cases, by sheets of a similar character, has prevented the escape upwards of the gas, and has rendered the working of these seams much more difficult and troublesome than those of the Transvaal where similar conditions do not exist.

Stone dusting is carried on at some of the more important collieries, and the dust is constantly sampled to assist in the detection of danger. The collieries which may be specially mentioned are Durban Navigation, Natal Cambrian, Natal Navigation, South African Colliery and Burnside. The accident at the latter mine in 1922, when 20 persons lost their lives, was believed to have been caused by a native opening his safety lamp. Electric lamps are now being installed at many collieries, and they give a far better light, of course, than the old oil burning safety lamp, and enable better examination of the working places to be made. The old-fashioned lamp, however, still has to be carried for gas testing purposes, and it remains probably the best practical indicator of danger in the hands of the experienced.

Electric coal cutters are coming more and more into favour and are successful in increasing the output where there is a good roof. The pillar and stall system of working is giving place to the long wall system in many collieries.

The length of the travelling ways is extending year by year, and causing a distinct problem to managements. A three mile trip underground with a low roof cannot increase efficiency of shifts underground, and mechanical haulage must be more and more resorted to.

The class of labour employed is, to a large extent, from the Indian coolie population, with a certain number of Kafir boys; the latter are generally of a stronger physique than the former, but the Indians are more intelligent and can earn better pay. The number of whites employed in these mines is considerably less in proportion to coloured men than is the case in the gold and metalliferous mines, and there has been a tendency to criticise the value of the industry to South Africa on this ground, and to complain that it is merely wasting one of South Africa's most valuable assets by exporting it. Such notions take, of course, a very short view of the value of an industry to a country.

That there has been waste both in the mining and the method of utilising coal in the past is undoubtedly true. The two seams which exist close together in a great part of the Natal coalfield near Hattingspruit and Dannhauser, have no doubt been worked wastefully, but there have been great difficulties to overcome in operating with the two thicknesses of coal so close together, and in waste in the utilisation of coal the whole world is the culprit.

The two seams are known as the Top and Bottom in the Hattingspruit district, and the Alfred and Gus in the Vryheid area. Both seams and the parting vary in thickness, the latter being at times as much as 40 feet.

A typical section through these seams gives:—top seam 3ft. 6ins.; sandstone and shale parting 2 to 4 ft.; bottom seam, 4ft. 6in.

While many of the collieries are so placed that they can be worked by adit in the hillside, these in the Hattingspruit district are worked by shafts, but do not exceed 700 feet in depth anywhere.

In working these seams, failure to leave large pillars to separate the mine into panels, and the leaving of the upper seam have resulted in heavy falls and gob fires, which have caused the direct loss of large areas of coal. Managements have realised the danger and the loss involved, and at some mines the difficulties are being met effectively, as at the Durban Navigation. It would take too long to recount the methods adopted, which are chiefly interesting to coal mining men.

Natal is already doing something to clear itself of the reflection that it is only exporting ruthlessly one of the country's assets. In 1922, the Dundee Coal Company completed the erection of a very up-to-date plant for dealing with bye-products of the coal at Waschbank. The works can produce 700 tons of coke weekly, 25 tons of tar, 8 tons of sulphate of ammonia, and small quantities of creosote and naphthalene. There is now a steady output from this and other similar plants in the Union.

COAL IN THE TRANSVAAL

In the Transvaal, coal was first systematically opened up near Boksburg in 1887, and it was this find in close proximity to the Rand which first held out the hope of being able to work the Rand beds on a large scale. Thus, on the East Rand there has been the remarkable spectacle of an area of ground proclaimed under the Gold Law for gold, producing coal from the same portion of land, the gold being worked under the Gold Law and subject to the Government's administrative control under that Act, while the coal is the property of the owner of the farm and worked by him under his ordinary base-mineral rights.

Coal in the Transvaal is found in four distinct geographical districts and is probably very extensive

(a) The present production comes from the High Veldt in the neighbourhood of Witbank, roughly in the area between the Eastern escarpment of the High Veldt and the Natal and Delagoa Bay main lines of railway, an area of some 500 square miles

(b) The Bushveld area north of Pretoria. The coal measures here are of considerable thickness but the coal is probably not of very good quality.

(c) The Lemombo area along the Eastern border of the Transvaal in the low country. This coal appears to be a good average quality, but somewhat anthracitic and is probably much broken by the neighbouring igneous rocks.

(d) The Limpopo area in the Northern Transvaal near the Messina Copper Mine. This is a poor grade coal so far as opened up by the Copper Company for its own purposes, but the coal measures are probably extensive, and in such a large area, there may be seams of better quality discovered in the future.

(e) The North Waterberg area which is really an extension westwards of (d) Limpopo area, which has been mentioned. Here the coal has been found in very thick seams at a very small depth there being four seams above 130 feet of 5, 7, 10 and 6 feet thickness, another of 22 feet at a depth of 300 feet, and at 330 feet another seam of 13 feet thickness. The lower seams are of ordinary local quality and quite up to the Transvaal quality, while the upper ones are very bituminous and of good coking quality, a fact which may be of great importance in the future.

As mentioned above, however, it is only in district (a) High Veldt that the greater part of the Transvaal coal is being produced to-day and the following table gives analyses of these coals —

ANALYSIS OF TRANSVAAL COALS *

Name of Colliery	Moisture	Volatilic Matter	Fixed Carbon	Ash	Calorific Value as per Mahler Bomb Process	Sulphur
Apex	5.25	17.27	50.00	27.30	9.03	1.14
Bellevue	5.75	31.47	52.40	12.32	11.34	1.50
Breyten	7.5	30.4	50.87	11.00	11.03	1.00
Laingo	4.50	24.50	52.00	17.50	10.50	1.50
Middelburg Steun	0.94	21.16	60.05	12.02	13.00	1.5
Ooies	3.20	0.36	50.34	13.50	12.5	1.4
Transvaal and Delagoa Bay	1.35	2.35	50.40	15.55	12.50	1.0
Witbank	0.94	7.04	50.90	13.52	15.01	1.4

* Report of Coal Commission

This High Veld area in the neighbourhood of Witbank supplies the greater portion of the coal used for ordinary purposes in the Transvaal e.g. by power companies, railways, mines and works, and it supplies the whole of the bunker export trade of Delagoa Bay. Although not equal to the quality of much of the Natal coal, the Transvaal coal has found its way into the Indian and eastern markets, and during the war it secured a footing in prices where it had hitherto been known. The bunker trade has often been adversely affected by the lack of equipment at the Portuguese port of Lourenço Marques, but a more enlightened policy now prevails and it may be accepted that the export trade of the Transvaal will expand rather than diminish. The seams in this portion of the Transvaal are very shallow and fire-damp is a very rare occurrence owing to the shallow depth of the seams. In some respects these seams are almost too near the surface and considerable subsidence takes place in many cases as soon as the last of the coal is drawn. Dr Mellor, formerly of the Geological Survey, wrote an exhaustive account of these occurrences to which the enquirer may be referred.

As figures show, the Transvaal coalfield, with its natural offshoot in the Northern Free State just over the Vaal River, is at present and is likely to remain the most important coal producing area of the Union, and the recently

discovered extensions northward appear to make the supplies of this mineral almost inexhaustible. Recent experiments go to show that several of the Transvaal coals are likely to produce a satisfactory coke, a most important consideration in reviewing the future of the coal industry in that province.

OIL SHALE AND TORBANITE.

Considerable attention has been paid in the past few years to the occurrence of oil shale and torbanite, in which the Union appears to be rich, although none of them have been worked. Several coal seams also appear to give very high distillates such as nitrogen.

These shales have been shewn to exist over large areas in the Ermelo and Wakkerstroom districts of the Transvaal as well as at Impendhle in Natal. Results of laboratory distillation tests are given in Major Trevor's paper "Mineral Wealth of the Union," and several companies have also made exhaustive investigation as to extent, working costs, and values of these shales.

As supplies of natural liquid oils decline, with the increasing demand for oil for all purposes throughout the world, no doubt these shales will ultimately prove remunerative to work.

TABLE II. COPPER AND TIN IN THE UNION—SALES AND SHIPMENTS

YEAR	TRANSVAAL		CAPRI		UNION OF SOUTH AFRICA					
	COPPER		TIN		COPPER.			TIN		
	Tons	Tons	Tons	Tons	Tons	% of Pure Metal	Value £	Tons	% of Pure Metal	Value £
1915	14,906	3,401	13,073	39	28,900	13.91	1,042,314	3,441	60.94	331,420
1916	12,242	3,235	10,598	29	22,841	40.06	1,137,380	3,264	66.16	330,571
1917	9,060	2,640	10,525	38	20,131	49.46	1,120,040	2,078	66.80	346,016
1918	5,205	2,100	1,669	15	6,874	52.12	342,105	2,206	72.16	440,995
1919	4,600	1,598	275	31	4,885	61.48	231,445	1,630	76.24	277,925
1920	2,688	2,452	7,862	10	10,880	45.55	418,260	2,463	69.54	435,686
1921	45	1,115	112	8	157	66.51	6,446	1,424	64.50	139,688
1922		612	795		795	93.33	38,622	612	68.16	59,987
1923	6,612	1,420	2,846	3	9,458	71.91	494,511	1,424	66.73	170,330
1924	6,574	2,051	3,384		9,958	86.67	530,824	2,051	65.91	305,396
1925	6,960	1,938	2,995		9,962	60.15	514,219	1,938	65.92	304,557
1926	5,091	1,784	3,271	6	9,235	68.88	494,852	1,791	67.65	310,898
1927	7,807	1,928	2,900		10,800	99.34	577,119	1,928	67.06	329,942
1928	7,970	1,992	2,861		9,872	99.47	603,243	1,992	67.47	268,618

COPPER (Table II.)

Next in importance to coal come the minerals, copper and tin. The iron ores and the development of a steel industry have already been dealt with in a recent paper read before the Royal Society of Arts, by Dr. Van der Byl, who was chairman of the Electricity Commission of the Union, and is at present connected with the Government scheme for the building up of a steel industry. With

regard to the prospects of this scheme and the possible markets for its output, I will, therefore say nothing now.

The most famous of the South African copper mines have been those of Namaqualand, where the Cape Copper Company and the Namaqua Copper Company produced copper with great regularity from about 1864 and 1887 respectively, up to 1918, when the price of copper fell heavily after the war.

The former Company's mines at O'okiep and NababEEP, and the latter's at TwEEfontein and Concordia have returned enormous profits over this period. The Cape Copper Company returned some £4,500,000 to its shareholders, while the Namaqua Company has distributed over 400 per cent. in dividends before the war. A visit to these mines is well worth making. Situated on the central range of Namaqualand, 60 to 80 miles inland from the Western coastline, they can be approached from the somewhat precarious roadstead euphemistically called Port Nolloth, or by car from Cape Town—usually a two days' journey over rough country. By either route a very arid country has to be crossed, the rainfall being about the lowest in the Union—2 inches at Port Nolloth—though a little more along the Central Hill range in which the copper mines are situated. Sea fog due to the cold antarctic current up this coast is about the only form of moisture on which the scanty scrub subsists. Occasionally a Northwest winter gale penetrates into the Namaqua range and gives a day or two's welcome downpour, and within two or three days the whole wilderness springs into a magic carpet of wild flowers, which covers it between the huge rock outcrops with incredible patches of yellow, purple, red and blue.

But with its peculiar charm few districts offer such poor facilities for mining; there is no timber, little water, and labour is scarce; and a tribute must be paid to the enterprise and persistence of the two companies I have mentioned. It was the Cape Copper Company which built the narrow gauge railway to Port Nolloth which has hauled up vast tonnages of machinery, fuel and stores, and brought down the ore for shipment. Here again at Port Nolloth, everything had to be handled by lighters towed out through the entrance in the reef to ships lying in the roadstead, shrouded four days out of five in dense fog and pitching and rolling to the heavy swell which rolls up almost incessantly out of vast spaces of the South Atlantic.

The country rock in which the Namaqualand deposits occur is massive gneiss. The ore occurs in dykes of various intrusive rocks, mica-diorite at Ookiep, hypersthénite at NababEEP mine, and norite at TwEEfontein—all of which tend to run into the gneiss and make the task of following the ore-body one of considerable difficulty, to which, however, the sharp eyes of the Cape boys are quite equal.

The ore occurred in a series of lenticular bodies in the gneiss, oval shaped and disappearing in depth into thin leaders, which again opened out into further ore masses; but each one smaller than the last, until the deepest became little larger than an office table. The whole character of deposit was laid bare in the

workings of the great O'okiep mine, where the vast stope cavities of the upper ore bodies gave place in depth to smaller and ever smaller excavations, until at last in the bottom scarcely a trickle of bornite could be seen. It would seem as if the ore deposition took place in increasing richness as it rose towards the surface and superincumbent pressures became less. The paying zones have practically cut out at 600 feet in O'okiep and Nababeep, although at Tweefontein ore has been extracted down to just under the 1,000ft. level. The stopes in the O'okiep mine are 70 to 80 feet across and as high as 120 feet, and when lighted up by men working far up their sides, form a magnificent underground spectacle, comparable with the great stopes in the old Great Laxey mine in the Isle of Man, and with those in the old Dolcoath in Cornwall, and with the Sheba in the Barberton district.

Many prospectors hold that a rich outcrop necessarily means good or better ore at lower depths, their slogan being "it must have come from down below, so there must be more if you sink to it," a line of argument which has proved very fallacious in the case of many promising outcrops of gold-bearing quartz reefs in the Transvaal and elsewhere.

Considerable tonnages of lower grade ores still remain to be worked, though the pristine glory is departed. Modern smelting plants have now been erected at all these mines with, as the figures show, a resulting increase in the percentage of ore exported. Development in Namaqualand to-day depends rather on the recent rich alluvial diamond finds in the coast belt and toward the Orange River Mouth. That strange mountain mass of the Richtersveld still calls to the adventurous and may yet yield some valuable copper ores.

The other famous copper mine of the Union is the Messina in the Northern Transvaal close to that other great river, the Limpopo. Very different are the scenic and meteorological conditions there. A vast grassy plain slopes northward to the river, formerly full of big game, malaria and Baobab trees. Now the game is disappearing—though a lion may still be met with when you are not expecting one—the malaria is being driven out by the efforts of the management under the enlightened administration of the Manager, Mr. Emery, and the Baobab trees are being exploited by a commercial company, while the old-fashioned waggon transport is now replaced by direct railway communication with the South.

The mine has been developed upon the site of a number of old workings, which first attracted the attention of capital after the Boer War. A mining lease was granted by the Transvaal Government, the area being situated in Crown lands. Production commenced in 1906 and increased steadily until 1916, when it began to fall, with the fall in the price of copper. After a considerable struggle owing to the low price obtainable, the mine shut down in 1921-22, when the Namaqua mines were in the same condition, though operations were resumed by 1923, and the mine has been producing an average of 6,000 tons per annum since then.

The tonnage, percentage of copper and value from the Cape and Transvaal mines respectively since 1915 are given in Table II (page 720), in which similar figures for tin are given.

The Messina ore occurs in a series of veins, which, though somewhat uncertain in value, are showing on the whole better in depth at some places than at the surface. The ore occurs in lenses in a zone of fractured gneisses, which form the country rock. This zone extends roughly for nearly 20 miles, and varies in width up to 300 feet. The bigger lenses are in the higher levels, but in the lower levels down to 1,300 feet, the ore is still present though more disseminated. The lenses occur so irregularly in the fracture zone that the results of development are very uncertain.

Copper has been found elsewhere in the Union in quartz veins in Hay Gordonias and Prieska, and at Insizwa in the Mount Ayliff district of East Griqualand, in this case associated with nickel and a certain amount of platinum. None of these have been developed commercially, but the last-named is a particularly interesting occurrence, dipping in under the great escarpment of the remote Insizwa Mountain.

A word must be said of the copper occurrences in that curious land, South West Africa. While extensive traces of copper are found all the way from the Orange River through the arid plateaux, and the stunted bush of the Northern Hills to Tsumeb, actual mining has only taken place in recent years at the latter place, in the Grootfontein valley, and in the desert mine of Khan. The latter with a huge and valuable plant, has not been able to produce copper at sufficiently low cost to survive the period of low prices.

The great Tsumeb mine with its huge mineral body and its complex ore, including copper, lead, zinc and silver, has produced some of the most wonderful individual specimens of various ores of copper to be seen anywhere. The exports from here and the neighbouring smaller workings have varied from 30,000 to 45,000 tons per year, and the whole of this ore used to go to Perthamby near New York for smelting.

While the Namaqua mines to the South have been largely worked by labour recruited from the immediate neighbourhood, and the Namaquas have proved themselves singularly efficient underground men, the Tsumeb mines have had to rely largely on labour imported from the Northern tribe of Ovambos, north of the Kunene. Efficient labour will probably always be one of the main difficulties which mining will have to contend with in South West Africa, the other two being transport and scarcity of water.

At the Messina mine an experiment was made with white labour on development work in place of the Kaffir gangs. Young white men of good physique were recruited locally at a fixed rate plus bonus for footage drilled. These men were employed in each place with two drills, and they fetch and carry their own drills. Some of these men turned out well.

TIN. (v. Table II.)

It is not a little astonishing, considering the army of energetic prospectors, who have for years scoured the Transvaal looking for gold, that tin was only discovered first in 1904. Cassiterite has now been found over a large area of the Bushveld, some 250 miles from East to West and about 100 miles from North to South, in the granites, and the felsites and sedimentary rocks at the contacts. The tin is found in joints and bedding planes and is very irregular. At Rooiberg and Leeuwpoot and Zaaipplaats successful mines have been developed which have produced regularly and have made the Transvaal one of the accepted tin-producers of the world. The tin is exported to the Straits Settlements where the best market exists. All these mines have had serious difficulties to contend with in the very irregular character of the tin deposits. At Zaaipplaats the miner has to follow a series of small trickling leads which run into larger pipes or lenticular bodies of rich cassiterite, which pinch in and out with the utmost irregularity. At Rooiberg the mineral is in vertical fissure veins with lateral enrichments passing into the country rock of remarkable value but tending to decrease in depth, all the richer values having been obtained within 100 feet of the surface. At Leeuwpoot the veins are flatter and richer, but the tin does not run into the country rock in the same way. It is interesting to note that these areas have been extensively worked for tin in the past, and that the ancient workings led to the discovery of the present mines. Who these workers were nobody knows—the present South African peoples known to us, having no knowledge of the working or use of tin.

The peculiarity of the Zaaipplaats ore occurrences is that they occur in irregular pipes or tubes wandering through the massive granite at all angles and in all directions, without any recognizable general trend of direction or dip. The cassiterite often appears like an eye on the surface from which it opens out and pinches and opens out again into massive cassiterite. There is often a casing of tourmaline, hard and well defined and disappearing gradually into the country granite. A large number of minerals are found in some of these pipes—mispichol, pyrites, scheelite, nolgranite, magnelite, molybdenite, galena, zinblend and fluorspar.

One of the longest and most productive pipes at Zaaipplaats has been followed for over 3,000 feet and in places gave a section of over 20 feet of solid tin-stone.

In the Eastern Transvaal and Swaziland, on the other hand, a fairly large alluvial tin field occurs, caused by the denudation of the pegmatites in the older granites. Owing to the heavy rainfall and the mountainous character of the country and the consequent concentration of the detritus, working is carried on by the comparatively simple and old-fashioned method of hydraulic and sluicing. It is said that this ore is remarkably free from impurities. The export is about 300 tons per annum, and at present rates of working these deposits should last many years.

In the Cape, cassiterite has been found in small quantities in the Kuils River district between Stellenbosch and Cape Town in small lodes considerably broken in the local granites. A certain amount of alluvial has been worked in the valley, but the amounts of tin actually shipped have been small, some 600 tons in all.

In South West Africa there is a very distinct zone of tin country running East and West of the remarkable granite mass of the Erongo Mountains, which form such a picture going northward from Karibib. There is another east of the Brand Mountains, and a third near Neineis. The output is steadily increasing, and it is possible that some rich discoveries in connection with the pegmatites may yet be made. The great difficulties are, of course, high transport and living charges, and lack of water.

The figures of Union exports of tin are given in Table II.

Of the remaining minerals produced in South Africa, commercially the more important are :—

Chrome Ore	..	...	about £25,000	worth per annum
Asbestos	...	..	£340,000	" " "
Corundum	..	...	£10 to 40,000	" " "
Soda	..	...	£30,000	" " "
Lime	...	...	£210,000	" " "
Salt	...	...	£140,000	" " "

From time to time galena, antimony, arsenic, iron pyrites, tungsten, manganese and graphite have shewn considerable export figures but are just now at low water level.

Certain minerals show a small but regular production and being of good quality with considerable reserves, are likely to add to the export totals considerably in future years. I refer to magnesite, mica and talc.

To give a few particulars of the more important :—

Chromite has been found to be widely distributed in what is known as the Bushveld Igneous Complex, North of Pretoria, in the lower portion of the Nor. tes, and have been traced through the Lydenburg and Rustenburg districts over a large extent of country. The chromite varies in thickness from six inches to six feet, but the occurrences are irregular and need careful following up in depth, as the dip varies very greatly, and a'long the strike. The chromic oxide content varies from 28 to 50%, the average being about 40%. In the Lydenburg area where the largest bodies occur the average is from 42 to 46%.

This ore has a larger content of ferrous oxide than the Rhodesian chromite. It is doubtful whether this should be considered a disadvantage for the making of ferro-chrome.

The Lydenburg ore can be delivered f.o.r. at Delagoa Bay at 35s. per long ton, and with the large reserves available an ever increasing export of this mineral is likely from the Transvaal.

TABLE III OTHER METALS AND MINERALS OF THE UNION SALES VALUES

Year	Antimony	Arsenic	Bismuth	Chrome (Ore)	Iron Ore	Lead	Manganese	Nickel	Vanadium	Lungsten	Zinc
	£	£	£	£	£	£	£	£	£	£	£
1915	2 105	—	—	—	—	1 830	—	39	—	—	2 214
1916	15,202	—	—	—	—	3 252	—	—	—	252	—
1917	12 428	—	—	—	—	3 761	641	—	—	1,551	—
1918	2 580	1 759	—	—	—	1 586	1 965	—	—	3 647	—
1919	536	663	400	—	—	1 051	276	—	—	640	—
1920	—	655	—	—	—	811	277	—	—	—	15,014
1921	120	120	—	400	—	5 270	566	—	—	—	4 410
1922	105	105	—	105	—	3 303	246	—	—	—	—
1923	290	290	—	—	30	133 573	1 584	—	2 710	—	—
1924	4 260	—	—	2 446	—	153 288	1 300	—	—	—	—
1925	790	—	—	21 001	—	55 066	817	—	—	—	—
1926	122	—	—	14 623	16 938	5 226	744	—	—	—	—
1927	1 336	—	—	24 939	29 686	7 543	345	—	—	—	—
1928	—	528	—	35 265	7 486	571	—	—	—	—	—

Year	Asbestos	Corundum	Graphite	Iron Pyrite	Kaolin	Magnesite	Mica	Mineral Paints	Soda	Talc	Total
	£	£	£	£	£	£	£	£	£	£	£
1915	35 890	480	1 204	939	10	1 568	150	—	20 949	218	67 610
1916	83 070	7 702	1 780	5 019	—	1 766	1 185	45	25 121	586	150 080
1917	87 364	13 038	2 590	4 463	19	5 050	577	305	29 377	1 962	166 426
1918	54 037	26 260	2 204	7 002	—	1 184	1 185	1 427	11 099	1 713	121 776
1919	66 426	1 486	2 030	5 894	—	—	360	572	—	2 170	95 071
1920	114 105	1 440	2 339	5 014	—	723	500	1 049	753	2 227	153 177
1921	103 007	770	1 496	6 632	—	3 786	502	333	—	1 306	130 302
1922	81 230	15 492	1 250	4 714	20	2 372	664	636	1 588	1 023	205 061
1923	121 453	22 543	1 837	4 906	40	2 943	1 038	468	1 018	1 065	295 704
1924	110 075	13 284	1 597	3 109	—	4 159	2 296	634	9 844	1 592	307 884
1925	152 115	13 229	1 510	3 400	—	4 007	4 577	—	13 480	262	271 154
1926	216 466	44 871	1 575	3 376	—	4 211	2 960	607	22 970	385	335 063
1927	343 301	8 473	2 027	3 091	—	3 935	3 754	1 867	32 710	2 740	465 777
1928	399 550	12 606	1 670	6 087	—	3 101	5 422	357	30 127	3 993	510 433

Asbestos.—The most interesting, the most widely distributed and the most valuable of the Union's non-metallic minerals is undoubtedly asbestos.

The Cape blue or crocidolite variety has been worked commercially in the Cape Province since the early nineties, though specimens of it used to reach this country long before that.

The increasing use of asbestos for all purposes where non-combustible and heat resisting material is required has resulted in an ever increasing output in the Union of this and the other varieties.

The chief varieties available in the Union are thus summarized by Hall:—

- (1) Chrysotile or White Asbestos—the well-known and valuable hydrated silicate of magnesia Transvaal and Natal.
- (2) Crocidolite or Cape "blue," a lavender blue ferrous silicate hornblende Cape and Transvaal.
- (3) Amosite, an ash grey ferrous silicate hornblende Transvaal.
- (4) "Asbestic," so-called a mass fibre variety of anthophyllite—Transvaal
- (5) Tremolite, silicate of lime—Natal.

(1) *Chrysotile*.—The best known occurrences are East of Carolina, and in the Kaapsche Hoep District of Barbarton.

The former is not yet important commercially but the latter, lying in a serpentine belt running underneath the Quarzitas of the great Drakensburg escarpment, which includes the picturesque and dominating kranzes of Kaapsche Hoep itself, is being actively exploited by the New Amanthus and other companies.

The working at the Amanthus is by adits, driven 70 feet apart, extending down to about 350 feet.

The fibre from what is known as the Ribbon Line is of excellent quality and is now well established commercially, and several grades are regularly turned out

A	...	...	...	...	...	over $1\frac{1}{8}$ inches
B	...	...	...	...	...	$\frac{3}{4}$ to $1\frac{1}{8}$ inches
E	...	...	...	...	...	$\frac{1}{2}$ inch upwards
F						
G	...	...	...	...	...	$\frac{1}{4}$ to $\frac{1}{2}$ inch.

The last two are prepared by milling, A and B by hand-cobbing, while E is prepared by a combined treatment.

The large number of seams, the superior quality of fibre and the ease with which the fibre is detached make this a potentially valuable discovery, and ensure low working costs.

The other companies are working on an eastern extension of these fibre veins in the same serpentine and they are quoting fibre up to two inches.

The chrysotile occurrence in Natal is situated in the Tugela valley and although the ruling length of fibre is less ($\frac{1}{4}$ to $\frac{1}{2}$ inch), it appears to be of very good quality, but so far it has only been worked at intervals.

(2) *Crocidolite*.—The large exploited Cape occurrences are situated in the banded ironstones of the Lower Griqua Town series, from south of the Orange River, northward right through Kuruman into British Bechuanaland, a distance of some 300 miles with a width roughly of 30 miles. As Hall says: "it is the most extensive stretch of asbestos bearing formation known." The present production which is from a variety of places is capable of almost indefinite expansion.

The southern section astride the Orange River has been developed by the Cape Asbestos Company with headquarters at Koragas, 35 miles north west of Prieska, their most famous mine being that at Westerberg where working has gone down to over 250 feet.

Generally speaking, the method of working especially in the northern section has been by the very old fashioned and simple method of open-cast, the work being carried on entirely by natives under their own initiative and in their own way. This way is generally wasteful, slow and uneconomic, but the combined output from a number of small workings becomes considerable.

Grading is based as usual on length of fibre and is as follows:—

X	...	...	...	...	...	up to $\frac{1}{4}$ inch
S	...	...	...	...	...	$\frac{1}{4}$ to $\frac{1}{2}$
A	...	...	...	...	...	$\frac{1}{2}$ to $\frac{3}{4}$
B	...	...	...	...	...	$\frac{3}{4}$ to $1\frac{1}{4}$
C	...	...	...	...	...	$1\frac{1}{4}$ to $1\frac{3}{4}$
D	...	...	...	...	...	$1\frac{3}{4}$ to 2
E	...	...	...	...	...	over 2 inches

The larger fibre from B to E is hand graded, the shorter grades are machine graded.

Two distinct sets of interbedded seams exist on Westerberg, each made up of from 3 to 7 parallel seams; they always occur as cross-fibre seams interbedded in the banded ironstones. At over 200 feet these ironstones become softer, but there is no deterioration in fibre quality.

In the Transvaal the crocidolite is restricted to the north east in the southern portion of the picturesque and beautiful mountain country of the old Haenertsburg goldfields, some 60 miles from Pietersburg. The seams are interbedded in the lower sections of the Pretoria series close to the dolomite. They are in ferruginous slates very like the Cape banded ironstone. They have only been opened up in recent years, but are capable of considerable development.

The crocidolite variety differs from the chrysotile in that it is credited with higher efficiency as an insulating material, both as regards heat and electricity, and with being unaffected by ordinary acids and chemical solutions, as well as by sea-water. On the other hand the chrysotile offers greater resistance to very high temperatures, and is softer and therefore more easily dealt with in milling and reduction.

(3) *Amosite*.—The crocidolite fibre mined at the famous mine at Penge shows remarkable lengths up to between four and seven inches, a virtue which has been anything but an advantage, as it proved too long for existing plants, and had to be cut to suit the market. This fibre is higher in iron than the ordinary variety, and contains very little soda. It was discovered in 1907, and has been worked in the Penge mine down to a depth of over 400 feet. Its name was given to it from the initial letters of the "Asbestos Mines of South Africa."

The Egnep and Amosa mines are the chief producers, and very large quantities of this asbestos have been opened up. There are three groups of deposit each consisting of several parallel seams occurring with the utmost regularity—a rare thing in asbestos deposits so that it has been possible to lay out the mine working with a regular system of drives and levels. The fibre maintains its length over long distances enabling a regular standard of over six inches to be kept.

The quality of amosite differs considerably from any other form of asbestos. The mineral is certainly rough and harsh to the touch but has great tensile strength and is to a certain extent elastic, quite a peculiar feature. The market for this fibre is bound to extend as its qualities become better known in Europe and America.

(4) *Asbestic* is a mass fibre hornblende associated with certain basic igneous rocks on the farm Korea about fifty miles west of Waterfont siding on the Messina line. It forms a valuable insulator when mixed with magnesia, and is made up for boiler lagging. Though not suitable for spinning it is suitable for manufacture into sheets and building material mixed with cement or magnesia. As large quantities are available and mining costs are low there should be a good market for this variety.

(5) *Fremolite*. This mineral is found in Zululand about 50 miles from Dundee. The deposit is in green talcose rocks, and is a pale greenish grey to whitish. A certain amount has been worked up into asbestos stone bricks, boiler lagging and for steam packing, but the amounts produced have not as yet been large.

It is interesting to note that whereas previous to 1920 practically the whole output of asbestos from the Union came from the Cape Province, since that date the discoveries referred to in the Transvaal have placed that Province in the leading position and in recent years the Transvaal has been producing at the rate of over 10,000 tons per annum.

Corundum.—No mining industry in the Union has suffered so severely from want of organization and co-operation between producers as that of corundum. Hand to mouth methods, laxity and irregularity in grading and want of capital to enable producers to finance their exports have told their own tale. Figures of export have fluctuated between 123 tons in 1921, and nearly six thousand tons in 1926. World competition and irregular demand in the European and

American markets for abrasives can be blamed to a certain extent, but by no means entirely for the state of the industry.

The corundum is found in the form of large broken crystals in the gneiss and schists of the Zoutpansburg and Barberton districts in the north and north-eastern Transvaal, and has been worked for many years now by the farmers in the former district around Bandolier Kop. The crystals occur in the surface detritus in a gravel about 2 foot thick, and are easily worked by native women and children, and working costs are low.

The parent rock appears to be interbedded in folds of the gneiss. With the exhaustion of the crystal corundum, "boulder corundum" of a compact massive character is found *in situ* running up to 60 per cent. corundum. Supplies appear to be unlimited.

The Transvaal Corundum Company and others have made efforts to establish the industry on a sounder basis and to ensure that regularity of output and grading which are essential in securing and keeping any market. That those efforts are bound to succeed in time because there is a large and reliable market and an equally large and promising field of supply, there seems to be no doubt.

Soda. This is produced from the remarkable occurrence at the crater-like depression known as the Pretoria Salt Pan, a few miles North of Pretoria. The bed of the pan is about 28 acres and consists of a black mud containing masses of trona, or solid crude carbonate of soda. The South African Alkali Co. has had a somewhat chequered career owing to difficulties of treatment, but it looks as if now the company had overcome its difficulties and had devised a successful plant.

Lime. Vast areas of the Union are covered by a great thickness of desert lime, and large sections of the Transvaal by the dolomite. It is hardly surprising therefore that the use of local lime is steadily increasing.

The common blue lime for building comes from ordinary kilns burning the magnesian limestone in several districts of the Cape and Transvaal, while white lime for chemical and metallurgical purposes comes also from cave fillings, stalagmitic deposits, etc., in the dolomites. At Taungs a large occurrence is being opened up.

The desert limestone generally contains a considerable amount of silica and other impurities; it is largely worked for making cement in the Free State, and at Pretoria and Mafeking.

The resources of the Union in lime have been carefully surveyed by Mr. Wyburgh of the Geological Survey.

Salt. There are no known deposits of rock-salt in the Union, but in the more arid stretches of the high veld numerous shallow depressions occur with no out-flow, sometimes of several square miles area, from which the waters of the rainy season are rapidly evaporated, with a resulting brine remaining close to and on the surface. Practically all the salt used in the Union comes from the working of these pans, the salt being obtained by solar evaporation in shallow dams.

A few of the larger producers are adopting artificial heat for final precipitation, and this tendency will probably increase. Much of the salt is contaminated by dust carried by the ever present dry winds blowing across the veld. The industry suffers from lack of organization, heavy transport charges and extreme poverty among many of the producers ; but the excessive competition has the advantage of keeping down the price to the consumer. The industry will continue to grow as the Union markets increase, and its resources are pretty well unlimited.

Generally speaking, the base mineral production in the Union is capable of indefinite expansion, but in all cases proper development ahead to ensure regular output, careful grading and care in quality of production, matters which may seem quite commonplace, but which have been too often neglected in the past, are essential to success.

As the local markets increase with the development of the natural industries of the country, using the raw materials which are at hand, so it will be possible to study and improve marketing abroad. In practically all the minerals referred to above there are large reserves available. I need only instance the recent discovery of large manganese occurrences at Postmasburg, where millions of tons of excellent ore are in evidence. It is satisfactory to know that long negotiations have at length been concluded, by which 65 miles of branch railway line is to be constructed to Postmasburg from the branch line at Koop Mansfontein, and a company is undertaking the working of these deposits at the rate of 200,000 tons for the first year, and rising to 500,000 tons in subsequent years.

Cost of transport is the ever-present difficulty in a vast country like South Africa, where even home markets are remote in point of mileage. Labour remains cheap in spite of increased competition from mines, industries, railways, householders, municipalities, all of which depend with ever-increasing insistence upon the good-natured and ubiquitous Kaffir inhabitant of the Union. Good roads are of the utmost importance in the present stage of the Union's history, to feed the railways, to bridge distances which only the motor car can economically link, and to unite points and communities hitherto remote and perhaps unsympathetic to one another and to the world at large. To none is improved transport more important than to the base mineral producers of the Union.

DISCUSSION

THE CHAIRMAN said all would have listened with very great interest to the lecturer's able account of the base metal industries of the Union. He was particularly glad that the matter of transport had been emphasised. All who knew South Africa realised what that meant—the distances were so vast, roads and railways were necessary, and it was essential that the transport should be as cheap as it could feasibly be made. There had been a tendency of recent years to go in the

other direction, for reasons which it would be out of place to discuss at the moment, but certainly the question of transport was a matter of the very first importance to the progress of industry in South Africa. The lecturer had confined himself to the Union of South Africa, but, looking beyond to the large areas of South Africa—in Rhodesia, for instance—one found the picture intensified. In Rhodesia, apart from precious metals and stones, there were two products which were of the utmost importance. The production of asbestos in Rhodesia was more than twice that of the Union. If the productions of asbestos of both Rhodesia and South Africa were added together, they came to a very large sum indeed expressed in money. Just to give some slight idea of the importance of that production of asbestos, he might point out that in the year 1927 the production from Canada, which was the biggest asbestos-producing country in the world, had come to 274,000 tons, and its value had been upwards of 10,000,000 dollars or, say, £2,000,000. The South African production had been only 60,000 tons—38,000 tons from Rhodesia and 22,000 tons from the Cape, but the value of it in the aggregate had been much more than half that of the Canadian production, namely, £1,300,000. Whereas the average value of the Canadian production had been about £8 a ton, the average value of the South African production had been £66 per ton. The reason of that was that the lower grades of asbestos were left behind in South Africa; they were not worth the transport, and were discarded, but in Canada the whole of the production was utilised. So that, looked at from the world point of view, Canada stood first, then Rhodesia, then the Union of South Africa, after which followed Russia. The second product which he had in mind was chrome ore. Rhodesia supplied the world with chrome ore. In 1925 she had produced 135,000 tons; in 1926, 181,000 tons and in 1927, 218,000 tons. Going to Northern Rhodesia, at Broken Hill there was the first zinc plant which had ever been worked in South Africa, and although it was on a small scale the deposits were large, and without doubt there would be in the future a very large production. The zinc ores of Broken Hill had also a proportion of vanadium in them—a mineral which, though not mined in great quantity, was of the greatest value. South Africa really supplied the European demand for vanadium. Huge deposits of copper had also been recently opened up in Northern Rhodesia, which would certainly not only have a local interest but a vaster interest from the point of view of the British Empire. Nature dealt lavishly in the matter of minerals with South Africa; she gave with both hands. She did not scatter her gifts of diamonds merely here and there, as in India and in Brazil, but she poured them out, as it were, in buckets full. When she gave gold, she gave it to the Rand in such quantities as to make that district far ahead of any other goldfield in the world in production. So it was with other minerals. There were endless supplies of coal and manganese ores. In Northern Rhodesia there were millions of tons of copper ores which were already proved. In a very few years that country would be a hive of industry. The lecturer had given a most admirable account of the mineral wealth of the country.

MAJOR T. G. TRIVOR, A.R.S.M. (Late Inspector of Mines, Union of South Africa) remarked that both before and during the time he had been a servant of the Union his duty had been to push forward the discovery and the mining of minerals. He had always been an optimist, and he was still an optimist; indeed, the only thing he was sorry for was that he had never been optimistic enough. He did not want those who were to attend the meeting of the British Association for the Advancement of Science in South Africa during the coming year, to imagine for one moment that everything which was to be found in the matter of minerals in South Africa

had been found, or that everything which was to be worked there was being worked. The lecturer had mentioned the copper at Messina. That copper at Messina had been found by ancient workers. There were many other ancient workings in the country, one of them very much greater than Messina, and it was not yet known what the ancients got from it, or when they got it. There were other workings where the ancients had presumably worked for specularite. He knew workings which he had measured up in several cases, where over 100,000 tons had been shifted by people who had known their job; and nobody to-day could state what that had been done for. It could only be presumed that it had been specularite, either for decorative or colouring purposes, but it took a good deal to imagine that those enormous quantities could have been used for such purposes. As an example of how long it took to find the value of things, although the manganese deposits to which the Chairman had referred had been mapped years ago by the Geological Survey, not a word had been mentioned then about their being of any possible value, because at that date there had been no probable value. Circumstances had altered since, and now those deposits were of extreme value. There was another deposit, small in size but economically important, namely, fluospar. In one district there was a place where the Boers had used to go for "pretty stones" to put on the graves of their relatives, and all over that district could be seen graves marked with lumps of fluospar. That material was now being worked by an American firm, which was producing a very large output. Then, again, there was copper and nickel in the Bush Veld. A very promising discovery had been made of copper nickel ores in magmatic form. Cobalt deposits, too, had not yet attracted the attention they deserved. It was the same story throughout the whole country. Dr. Hall in 1906 had called attention to the fact that platinum was likely to occur in the Bush Veld, and Dr. Hall and the writer had done their best to persuade people to take it up but the time then had not been ripe for it. Later on the metal had been discovered by accident by an old alluvial digger digging a watercourse for his potatoes. That was how discoveries happened in South Africa, and was why he asked those who were going there not to think that everything was known about the mineral resources of the country. He himself, in going about the country in past times, had picked up very valuable specimens of radium ores, but had only recently recognised what they were. The whole country was teeming with possibilities of new discoveries.

MAJOR W. P. SWINBURNT, A.R.S.M. (Late Chief Inspector of Mines, Union of South Africa) said it used to be the custom 40 years ago, a custom which had perhaps now fallen into disuse—for the best blood of the country in the shape of younger sons, to go abroad out of this congested country and win new lands and possessions. Those lands and possessions had been won by the Englishman for England, but what had happened? The politicians had given them back. Did England own South Africa to-day? Was there any English trade in South Africa to-day? The bulk of the trade was not English. South Africa had been lost to the British Empire. It was said that trade followed the flag. Where was the flag in South Africa to-day? The South African flag was flying a few hundred yards from the present building, easy for everyone to see, but was the flag of England easy to see in that South African flag? Mr. Warrington Smyth, Major Trevor and several others present, had been humble musket bearers in the old ranks along with himself of that splendid British administration which had been formed after the Boer War to govern South Africa—an honest English administration at whose head Lord Milner had stood. Where in South Africa were our great administrators to-day? Where was our English trade? What good were all these vast mineral assets to the British

I inquire to day That was the question to put Were the people of this country going to continue to allow their younger sons to go out and win lands and at the same time allow the politicians to give back those lands when they had been won

SIR RICHARD REDMAN, K C B said all present were extremely grateful to the lecturer for having produced such an admirable paper—and if he might say so a very timely paper With regard to coal and oil shale deposits he would like to ask the lecturer whether the Indwe coalfield in Cape Province was being worked at the present time or whether it had been entirely abandoned It produced a very low grade fuel and had been the first coalfield worked in South Africa The lecturer commented on the high class coal which existed in Natal He was inclined to join issue with the lecturer in his comparison of it with high class north country coal There was something more than merely the calorific value which commended a coal

The nature of the ash and the manner in which the coal burned had to be taken into consideration The ash content of the Natal coal was on the average nearly twice that of north country coal Some of the Natal coal which had a high calorific value had unfortunately in ash which was very fusible which was very detrimental to use for steam raising purposes especially at sea He had been very interested in what the lecturer had said with regard to the effect of the basaltic dykes

causing the coal to become anthracitic and imprisoning gas in gas tight compartments He had made out a calculation in Natal from a number of bores which he had put down to the effect that if the basaltic overflow was from 150 to 250 ft in thickness wherever it approached within 250 ft vertically of the coal the latter was always adversely affected He had seen at the same time the extraordinary phenomenon of a dyke traversing a coal seam and leaving it unaltered and not many yards away another dyke which had altered it completely for yards It was a phenomenon very difficult to account for There was an interesting thing about the nature of the gas The gas which he did not think was the characteristic of marsh gas as developed in British coalfields seemed to contain helium If that was so it might be that that was another influence brought about by the dykes

With regard to the oil shales he would like to inquire as to the sulphur content There were very extensive oil shale deposits in this country—in Norfolk for instance

which were practically valueless although they gave a very good oil return on distillation The oil was so sulphurous that it was worthless It would be interesting if the lecturer could give any information on that point He would also be obliged if the lecturer could give any information as to the possible commercial value of the recent remarkable discovery of radium ore at Gordonia in the north west of Cape Province

DR W KUTTERBUCK said he appreciated the lecture because there was no one else who was in a better position to talk about the subject than the lecturer There were a few points with regard to the grading of these minerals which were of particular interest to himself and he pointed to the example of the grading in the case of the coal exports of South Africa first of all in Natal and later on established by legislation in the Transvaal In the case of the minor base minerals such as asbestos and mica there had been various difficulties about the marketing in England and on the continent of America To a large extent those difficulties had been due to a lack of knowledge of the markets and also partly to the ignorance and perhaps the inability of the producers in South Africa to produce and deliver the goods over a continuous period With the exception of

asbestos, which was now a well-established industry, most of the other minor minerals were worked by small miners, who eked out a precarious existence and worked spasmodically and not over continuous periods. During the last year or two he had been studying the matter of marketing those minerals, and there was at present a conscious effort being made in South Africa to regulate and control the sale and exportation of those minor minerals on similar lines to the coal business. A Bill had recently been enacted which made provision for the Government regulation of some of those minor minerals. At present those provisions had only been worked out and applied to the export of corundum, with very good results, and they might be extended to some of the other minerals as occasion demanded. His impression was that in South Africa they were trying to live down the rather unwelcome epithet which used to be applied to South Africa, namely, that it was a land of samples. Provision was being made so that the quality of the minerals exported would be guaranteed.

MR. WARINGTON SMYTH, in reply, said he agreed with the last speaker that efforts were being made to deal with the question of grading. Parliament had seen the necessity of doing something in that direction. With regard to the questions raised by Sir Richard Redmayne, he understood that a certain tonnage was still being produced from Indwe Colliery, but it did not exceed 5,000 tons a year. The discussion with regard to Natal coal qualities was one which was perennial. There had been so many opinions expressed that it was a most dangerous subject to enter upon; in fact it was just as gaseous as the deposits of coal themselves, and nobody should enter upon it with a naked light! Sir Richard had tried to start a spark in it that afternoon! With regard to the influence of dykes on the seams, a man like Steart, who had been in the Geological Survey, would be able to keep the audience interested the whole afternoon by giving the results of the effects of those dykes as observed on the coal, and by describing the conditions which had been found in some of those gas-tight compartments under those over-flow sheets. The interferences were very strange and very unequal. It was an interesting subject but a very large one. With regard to oil shales, he had not made that one of his own subjects. Major Trevor had been an enthusiast with regard to oil shales, and some had accused him of being unduly optimistic. Very little was known—at all events not sufficient to enable anybody to pronounce anything definite, and that was why he had skipped over that subject rather lightly in the paper. He could not state what the sulphur content was of those shales, but he would find out. With regard to the recent discovery of radium ore, he was sorry to say he had not information about it sufficient to enable him to pronounce any opinion upon it.

Votes of thanks to the lecturer and to the Chairman having been passed unanimously, the meeting terminated.

OBITUARY.



THE EARL OF ROSEBERY, K.G., K.T. By the death of the Earl of Rosebery, which took place at his residence, The Durdan, Epsom, on May 21st, the Society has lost not only one of its most distinguished, but also one of its oldest, Fellows. His Lordship was elected a Life Member in 1876, and had thus been on the roll

for fifty-three years, and he served as a Vice-President of the Society and a member of the Council for two periods, 1894-7 and 1909-12

Full justice has been done to the many-sided brilliance of Lord Rosebery in the obituary notices which have appeared in all the leading newspapers. In statesmanship he held the high offices of Secretary of State for Foreign Affairs and Prime Minister, in literature his works on Napoleon, Cromwell, Pitt and Chatham are regarded as classics, in oratory he was excelled by no one of his time, and in the very different sphere of sport, he was three times winner of the Derby.

JOHN T. MARTEN, M.A., I.C.S. — We regret to announce the death on May 11th at Juan-les-Pins after a short illness, of Mr. John T. Marten, who was staying there on leave preparatory to retirement from the Indian Civil Service, of which he was a distinguished senior member. Born on September 28th, 1872, he was educated at Clifton and New College, Oxford, and entered the Indian Civil Service in 1896 being posted to the Central Provinces. After serving as Assistant Commissioner and Deputy Commissioner in various districts, he successively filled a number of important positions being Excise Commissioner in 1906-7, Superintendent of Census for the Central Provinces and Berar from 1909 to 1912, Financial Secretary and Chief Secretary from 1913 to 1916, Inspector-General of Police, 1919, and Census Commissioner for India from 1919 to 1923. In his Census Report on the 1921 census an able and well-written document Marten struck out a new line by devoting a considerable amount of attention to the analysis of occupational tendencies. In 1925 he was appointed a member of the Central Provinces Executive Council and two years later he acted as Governor and was made a C.S.I. In 1923 he read a paper before the Society, on 'The Indian Census of 1921' and again in 1925, another paper on 'Population Problems from the Indian Census'.

NOTES ON BOOKS

(R)IATIVE EDUCATION AT AN ENGLISH SCHOOL By J. H. Whitehouse Cambridge University Press 16s

The system of education practised at Bembridge School is deeply interesting. As to its great superiority to the established public school methods there seems no doubt at all. Whether the results are going to be correspondingly great depends first on human nature and a variety of adventitious circumstances. Secondly I need hardly say—on the point of view

just as sending boys to chapel does not necessarily make them religious, so sending them into a studio does not necessarily make them lovers of art. Nor is it ever possible to foresee the result of a conflict, so to speak of contaminations. When the followers of Wesley became a nuisance to the authorities many of them were impressed into the army, where it was hoped they would soon be swearing and drinking again with the best. But the wrong germ proved the more hardy, and for the time being the British Army became the worthiest, most edifying body in the country.

The question then is: With regard to Bembridge and similar institutions will the spirit of art carry the day and purify the public school atmosphere, or will the public school atmosphere prevail and taint the spirit of art? Very reassuring on this head is the tone adopted by Mr. Whitehouse in his book. He writes, in the most natural way in the world, of "values." In my years at one of the three most famous public schools in England I did not once hear from a master that

there were such things as values. In so far as any values were hinted at, they were sham ones; not real values, mere matters of expediency, to which a monstrous importance was in all manner of subtle ways attributed.

But Mr. Whitehouse speaks of "developing the personality;" of "a fuller and richer life;" and he expresses views about individualism beside which the ideals of the ordinary public school sound as false as the nonsense about "service" which we cannot avoid seeing every day in the papers and on the hoardings. That such provincial notions, as a basis for education, should flourish two thousand years after Plato is extraordinary. Bembridge at least sees the individual *sub specie eternitatis*, and if a Leonardesque versatility is held up as an ideal to the boys, this is less absurd and less dangerous than urging Smith Minor to fancy himself, in anticipation, ruling "imperio populos" and taking Roman measures against the "superbos."

I can very well imagine a critic saying: "Yes, but is this kind of education at Bembridge a fitting preparation for the world? There is not a very large demand for woodcuts, calligraphy and so forth. Nor are the studio and workshop a true microcosm of life as it is." The Bembridge boys will be sadly disillusioned when they leave if they think so.

To which the answer is: "There is an even smaller demand for ability to kick a football and drill a platoon. And in what way do the traditions of a sporting and independent gentry help a boy to travel in oil or adapt himself to the routine of an office? At any rate, the arts, and interest in the arts, are good things in themselves. One can never be disillusioned through having cultivated a contemplative imagination. Disillusionment may well come if one has acquired the outlook and, incipiently, the virtues of a Roman patrician, and, as the son of a comparatively poor professional man, has nothing—neither money nor leisure—with which to support one's pretensions.

For all the feeling there is nowadays about "progress," only a minority can be found to believe that the road to our ends may be an intellectual or psychological one. The majority acquiesce uneasily in the dogma of salvation by increased production. When the young Gladstone was still a Tory he wished the West Indian slaves to be set free, if at all, by a series of elaborate stages. "Such men are born slaves," he might have begun his speeches in the House, and so, for wretched reasons, they were. Likewise it seems to the timid that a short cut to culture must be dangerous for a community steeped in original sin. But it is high time these "si vis pacem para bellum" paradoxes were finally exploded; if we really wish for peace we do not arm to the teeth, and if we want boys to be educated we must not lead them into the camp of Goliath.

The modern man is ingenious and inclined to be humanitarian, what he conspicuously lacks is *taste*, which can alone give him confidence when it comes to selecting the materials for a true civilisation. We acquire taste by training our sensibilities, and this is done most conveniently and satisfactorily by concentrating our attention on one or more of the arts. For this reason the Bembridge methods appear excellent. If practising various arts does not lead the boys to perfection it will anyhow lead them to better appreciation, and make it impossible for them to accept the raw standards of culture which seem quite tolerable to the average public school boy. "The common saying, that tastes are not to be disputed . . . corresponds with the notions of those who consider (taste) as a mere phantom of the imagination, so devoid of substance as to elude all criticism." Sir Joshua Reynolds dealt with this fallacy in his seventh Discourse. Bembridge deals with it also. The fortunes of this school should be carefully watched. P.B.

GENERAL NOTE.

SUMMER SESSION IN HISTORY OF ART AT PARIS.—The Institute of Art and Archaeology of the University of Paris offers a summer session in the History and Appreciation of Art, opening on July 1st and lasting for seven weeks. The session is open to students, both men and women, of all nationalities. The courses are designed to meet the needs of the following persons: university and college students who expect to specialise in art with a view to becoming teachers of art, curators of museums, architects, art workers, and writers; teachers of art and curators of museums who would like an opportunity to take advanced instruction, acquire new points of view, and study directly the art treasures of France; students or teachers of French or of History particularly interested in Art. The programme comprises six courses: Greek and Roman Antiquity; Medieval Art; The Art of the Renaissance; French Classical Art; French Painting in the XIXth and XXth Centuries; Museum Training. Conducted tours will be arranged to museums and other places of interest. A limited number of rooms at the Cité Universitaire will be reserved for students, while those who prefer to reside with private families can procure lodgings at selected pensions. Circulars giving further information about the session may be obtained by writing to: M. Henri Govy, Head of the Information Office, Sorbonne, Paris (V°).

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

MONDAY, JUNE 3. Geographical Society, Lower Lodge, Kensington Gore, S.W. 4 p.m. Special General Meeting for Revision of Bye-Laws.

Royal Institution, 21, Albemarle Street, W. 5 p.m. General Meeting.

University of London, at King's College, Strand, W.C. 5.30 p.m. Prof. F. Karrer, "Organic Chemistry." (Lecture II.)

Victoria Institute, at the Central Hall, Westminster, S.W. 4.30 p.m. Sir Ambrose Fleming, "Nature and the Supernatural."

TUESDAY, JUNE 4. Anthropological Institute, 52, Upper Bedford Place, W.C. 4 p.m. Mr. T. A. Rickard, "The Discovery of Metals."

Illuminating Engineering Society, at the ROYAL SOCIETY OF ARTS, Adelphi, W.C. 7 p.m. Annual General Meeting.

University of London, at King's College, Strand, W.C. 4.30 p.m. Sir Bernard Pares, "Contemporary Russia." (Lecture VI.)

At University College, Gower Street, W.C. 4.30 p.m. Mr. Robin Flower, "Life, History and Folklore of a Kerry Island." (Lecture III.)

WEDNESDAY, JUNE 5. British Commonwealth League, at the ROYAL SOCIETY OF ARTS, Adelphi, W.C. 10 a.m.

University of London, at the London School of Economics, Houghton Street, W.C. 5 p.m. Dr. Hubert Hall, "Some New Aspects of Town and County Life in Mediæval and Post-Mediæval Times." At the School of Oriental Studies, Finsbury Circus, E.C. 5.15 p.m. Prof. Jules Bloch, "Some Problems of Indo-Aryan Philology." (Lecture I.)

THURSDAY, JUNE 6. British Commonwealth League, at the ROYAL SOCIETY OF ARTS, Adelphi, W.C. 10 a.m. Chemical Society, Burlington House, W. 8 p.m.

(1) Messrs. F. Challenger, L. Klein and T. K. Walker, "The Production of Kojic Acid from Pentoses by

Aspergillus Oryzae." (2) Messrs. T. M. Lowry and G. Jessop, "The Properties of the Chlorides of Sulphur. Part II: Molecular Extinction-coefficients." (3) Messrs. M. S. Leslie and E. E. Turner, "The Isomerism of Derivatives of 2-Phenyl-naphthylene-1,3-diamine." (4) Messrs. T. M. Lowry and F. L. Gilbert, "Studies of Valency. Part XIII. Further Experiments on the Molecular Structure and Configuration of the Quadrivalent Derivatives of Tellurium."

University of London, at King's College, Strand, W.C. 5.30 p.m. Mr. A. F. Heyendorff, "The Class-struggle Idea in Current Soviet Legislation and Administration." (Lecture I.)

5.30 p.m. Prof. F. Karrer, "Organic Chemistry." (Lecture III.)

At St. Thomas's Hospital, Albert Embankment, S.E. 5 p.m. Prof. S. J. Cowell, "Dietetics." (Lecture VI.)

At the School of Oriental Studies, Finsbury Circus, E.C. 5.15 p.m. Prof. Jules Bloch, "Some Problems of Indo-Aryan Philology." (Lecture II.)

FRIDAY, JUNE 7. Philological Society, at University College, Gower Street, W.C. 5.30 p.m. Dr. C. I. Onions, "The Supplement."

Royal Institution, 21, Albemarle Street, W. 9 p.m. Mr. C. Leonard Woolley, "Excavations at Ur, 1928-1929."

University of London, at King's College, Strand, W.C. 5.30 p.m. Dr. H. Wildon Carr, "The Philosophy of Leibniz." (Lecture I.)

5.30 p.m. Mr. F. H. Marshall, "Capodistrias in Greece."

At the London School of Economics, Houghton Street, W.C. 4 p.m. Mr. Philip Noel Baker, "The Consequences of the Paris Pact for the Renunciation of War." (Lecture I.)

At the School of Oriental Studies, Finsbury Circus, E.C. 5.15 p.m. Prof. Jules Bloch, "Some Problems of Indo-Aryan Philology." (Lecture III.)

At University College, Gower Street, W.C. 5 p.m. Mr. Arthur Stratton, "French Romanesque Architecture."

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 3994.

VOL. LXXVII.

FRIDAY, JUNE 7th, 1929.

*All communications for the Society should be addressed to the Secretary, John Street
Adelphi, W.C.(2.)*

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

FRIDAY, APRIL 12TH, 1929.

SIR STANLEY REED, K.B.E., LL.D., in the Chair.

THE CHAIRMAN said he did not know exactly what the functions of a Chairman were on such an occasion, except that it was his duty not to stand between the lecturer and his audience. He would content himself, therefore, with saying that they were all exceedingly fortunate in having Mr. Cooper to address them that afternoon on recent electrical developments in India. It had been his good fortune to be associated with Mr. Cooper for some twenty years. During that time he had learned to lean with entire confidence on Mr. Cooper's very high professional qualifications and his very wide experience of electrical problems in India. Without more ado, he would ask Mr. Cooper to be so good as to read his paper.

The following paper was then read:—

RECENT ELECTRICAL PROGRESS IN INDIA.

By A. T. COOPER, M.INST.C.E., M.I.MECH.E., M.I.E.E., M.CONS.E.

Long before the uses of electricity began to enter into the lives of the people of India, monuments to the skill of engineers in the form of water, drainage, and irrigation works had contributed to their health and prosperity, but recently it may well be claimed that, so far as the larger centres of population are concerned, the electrical branch of engineering has played a more intimate part in their lives than any other.

ELECTRICAL IMPORTS.

As a broad indication of electrical progress, statistics of recent imports of electrical machinery and apparatus into India may first be referred to:—

During the past five years the total annual value of imports of Electrical apparatus, machinery and accessories has averaged $5\frac{1}{2}$ crores of rupees (about £4,000,000), and has not varied more than 10 per cent. on either side of that average.

Although this figure includes the cost of replacements of existing articles, which have worn out or become obsolete, it does not include that of the many items of plant and material ancillary to electrical development. Assuming that the addition on the one hand cancels the omission on the other, and bearing in mind the growing tendency to manufacture many small electrical articles in the country, the steadiness of the absorption may be deemed to be indicative of substantial progress.

Dealing with the many applications of electricity it is only right to commence with the senior service.

TELEGRAPHY.

The principal improvements in land line working, which have been introduced by the Government of India Telegraph Department during the last six or seven years, have been in connection with long distance circuits employing high speed printing systems.

The installation of Regenerative Repeaters or Retransmitters has rendered quadruple "up-and-down" working on the Baudot System possible over the longest circuits operated by the department, the lengths of some of which are shown by the following table :

<i>Terminal.</i>	<i>Distance. Miles.</i>	<i>Retransmitting Station.</i>	<i>Distance. Miles.</i>	<i>Terminal.</i>
Calcutta	703	Nagpur	521	Bombay
Calcutta	555	Vizagapatam	489	Madras
Calcutta	626	Akyab	446	Rangoon
Madras	347	Madura	379	Colombo

Calcutta—Agra 808 miles and Bombay—Agra 843 miles are worked satisfactorily without any intermediate retransmitting station.

Specially designed Baudot Typewriter keyboards and converted Murray keyboards with tape transmitters have been recently installed on some of the main circuits as a labour saving experiment, and their operation is being closely watched.

On short and less important circuits similar efforts towards savings in labour and plant have been made by the introduction of modern types of concentrator switches and of the composite method of Morse working, while in the large Telegraph Offices Lampson Carriers have been installed for the conveyance of messages to and from the Instrument Tables.

With regard to Radio Telegraphy, stations for point to point working were installed in the Bay of Bengal as early as 1905, and in 1918 there were some 30 stations of the spark type in operation. These have since been fitted

with continuous wave transmitters and receivers employing three-electrode valves.

A high-speed duplex radio service between Madras and Rangoon was opened in 1923, but owing to trouble from atmospheric conditions during the S.W. monsoon it was abandoned in 1926.

The most recent application of radio telegraphy is of outstanding importance. In 1925 the Indian Radio Telegraph Company was floated for the purpose of establishing a system of reciprocal communication between India and Great Britain, and a short wave transmitting beam station at Kirkee near Poona, and a receiving station at Dhond, were officially opened by the Viceroy in July 1927, and came into regular public use two months later.

The British Stations are situated at Grimsby (transmitting) and Skegness (receiving) and are connected by land lines with the G.P.O., London, the Indian Stations being similarly connected with the G.P.O., Bombay.

Under the contract with the Government the Indian beam system was to be capable of sending and receiving at the same time a minimum of 100 words a minute each way over a 12 hour working day, but this minimum was largely exceeded on test when a speed of 130 to 150 words a minute over an 18 to 21 hour stretch was found possible, so that the capacity of the system is estimated at 180,000 words a day in each direction.

The success of the "Empiradio" service was immediate, and the volume of traffic so far exceeded the estimates as to constitute an actual embarrassment, for the initial staff engaged was found to be inadequate to deal with it, and some difficulty was experienced in training recruits while at the same time keeping the service in operation.

An extension of the beam system from India to other countries is under negotiation, and developments in this direction are anticipated as soon as the merger between the submarine cable and radio interests has come into active operation.

Further uses for Radio Telegraphy will no doubt be found in India such as navigational direction finding (stations at Karachi, Bombay, and Calcutta having already been installed) and also for communication with Lightships and Police Outposts.

TELEPHONY.

Developments under this head may be broadly divided into two classes :-

- I. Those relating to the modernising of old exchange equipment.
- II. Those in connection with long-distance working with the aid of Thermionic Repeaters.

Within the last few years a number of automatic exchanges have been installed by the Government in place of the original manually operated plants. Details are as follows :-

<i>Name of Exchange.</i>	<i>Size.</i>		<i>Type of Automatic Equipment.</i>
	<i>Present Equipment (Circuits).</i>	<i>Ultimate Capacity (Circuits).</i>	
Delhi	1,500	3,000	Peel-Conner, Machine Switching.
	1,400	3,000	
Cawnpore	500	2,000	Ditto.
Nagpur	200	500	All-Relay (Relay Automatic Co.).
Poona	500	1,000	Ditto.
Amritsar	700	700	Strowger (Machine switching).
Rawalpindi	500	600	All-Relay (Relay Automatic Co.).
Quetta	300	300	Ditto.
Allahabad	220	300	Ditto.
Bengal Coalfields Ex-			
changes (4)	780	2,000	All-Relay (Peel-Conner).
Ootacamund	150	300	Ditto (Relay Automatic Co.).
Conoor	150	300	Ditto
Meerut	80	160	All-Relay (Peel Conner).

Upon the working of these exchanges the Government will shortly be in a position to decide which system of automatic working is best suited to Indian conditions.

The telephone service in the three Presidency Cities, and also in Karachi and Ahmedabad, are in the hands of private companies working under License.

Bombay (9,000 subscribers) and Madras (3,000 subscribers) have both recently changed over to automatic working, but Calcutta (9,000 subscribers) still retains manual operation.

Extensive development in the Government long distance trunk service has recently taken place, and the network is now very comprehensive.

For distances of over 350 miles Thermionic repeaters are used, and the quality of speech transmission is claimed to be good as a rule up to 1,000 miles, but beyond this distance, difficulties in maintaining uninterrupted communication are met with. In the absence of "interruption" or "disturbance," "commercial" speech is sometimes possible between Calcutta and Bombay via Delhi, a distance of 1800 miles, but as compared with Europe and the U.S.A., India is evidently rather backward in long distance Telephony in spite of the urgent need for an efficient service for linking up the ports with the Capital and with industrial centres.

So far no provision for inter-continental telephony has been made, but it forms part of the future programme of the Indian Radio Telegraph Company.

PUBLIC SUPPLY OF ELECTRICAL ENERGY.

A general supply of electrical energy is now available in all Indian cities of any importance, while many Licenses for supply in the smaller urban centres have recently been granted. In the secondary towns, with few exceptions, oil engines have been utilised as prime movers, while in the larger, apart from Bombay, steam turbines and water tube boilers form the medium for the transformation of thermal into electrical energy.

The demand per head of population varies over wide limits ranging from 5 or 6 units per annum in some of the smaller cities to about 200 in the case of Bombay. Even the latter figure is far below those reached in Europe and America.

The following notes record some recent developments in the principal cities, taking them in the order of relative population of areas of supply :

Calcutta. The demand for electrical energy in this great city has recently increased very rapidly, and energetic steps have had to be taken by the Electric Supply Corporation, under the Chairmanship of Lord Meston, to keep pace with the requirements of their area with its population of one and a half millions.

In 1925 100 million units were sold. Last year this output reached 148 millions while the estimate for the current year is 168 millions. Truly remarkable progress.

The first section of a new Southern Power Station laid out for an ultimate capacity of 150,000 kilowatts came into operation at the end of 1926. This is equipped with stoker-fired water-tube boilers and turbo-alternators generating at 3-phase 6000 volts, circulating water being taken from the river Hooghly.

24,000 kilowatts of plant have so far been installed and a further 15,000 kilowatt set is due for installation this year.

Although this new station was designed more with an eye to high reliability and low maintenance than to spectacular steam results, only 200 lbs. pressure and a total steam temperature of 600° Fahrenheit being utilised, yet its actual performance works out favourably when compared with the modern home stations of the same size and equipped for much higher steam pressures and temperatures, the overall thermal efficiency for last year being in the neighbourhood of 14%, and this in spite of the many tropical disadvantages met with, including circulating water running at times up to 93°F.

The Southern Station is linked up with the older Northern Station at Cossipore by means of two 6,000 volt trunk feeders laid along separate routes.

The leading developments to be noted with regard to the general supply in the city are the recent completion of the transfer of the Tramway Company's load to the Electric Supply Corporation and the substantial progress made in the electrification of the Jute Mills and other large industries.

An interesting recent addition to the distribution system is a large Rotary Substation arranged for an ultimate capacity of nearly 40,000 kilowatts of converter plant. As this is situated in a somewhat critical position in the bazaar it is fully equipped for "siege conditions" during periods of communal disturbances, special window and door protection being arranged, together with provision for rationing and for emergency sleeping quarters for the running staff.

Bombay. The outstanding recent development in connection with the general electric supply in Bombay was the completion of the change-over from a thermal power station to bulk hydro-electric generation. For many

years the Electric Supply and Tramways Company, although owning a large steam power station on the waterside, had taken supply from the Tata Hydro group in outlying districts to avoid the necessity of running out costly feeder mains, and when, owing to the rapid increase in the demand, they came to be faced with the necessity for major extensions to their power station, a contract was entered into with the Hydro Companies for their entire requirements. The change-over necessitated building a large Receiving Station alongside the steam power station. This is fed at 20,000 volts 3-phase from the Tata Receiving Station, and is equipped with 20,000/5500 volt transformers and the necessary switchgear. The change-over of the 5,500 volt feeders to the new receiving station was of necessity a gradual one, but the whole of the load was finally transferred in January 1926, and the power station shut down.

A more recent development in Bombay City has been the decision to deal with the direct current area in the Fort district by means of remote-controlled peak-load rotary converter substations located at strategic points and operated from a central control office. The manual attention to these substations will be restricted to periodical cleaning and overhaul.

As regards the general tendency of public electricity supply in this city, it is interesting to record that the middle-class Indian has not been slow in taking advantage of the domestic amenities which electricity has to offer in the way of refrigerators, water heaters and electric cooking appliances, while the electric *dhobi* is rapidly gaining favour, and the charcoal *sigri* will shortly become a suffocating memory.

The recent decision of the G.I.P. Railway to instal electric cooking apparatus throughout the large restaurant in the new building at their Victoria Terminus constitutes a significant confirmation of the adaptability of this application of electricity to Indian conditions.

The B.B. & C.I., the other railway running into Bombay, have adopted flood-lighting of their administrative block for notifying the arrival of their mail trains at night.

Madras. This third city of India, the "City of distances," with its 27 square miles of municipal area, and 300 miles of thoroughfares, is supplied with electrical energy on the same lines as those obtaining in Bombay and Calcutta, i.e. Direct Current in the centre and Alternating Current in the outskirts.

The Madras climate, which has been described as "three months hot and nine months hotter," calls for the continuous use of electric fans which, while contributing to the satisfactory annual load factor of 45 per cent., have been recently utilised as a means of improving the power factor of the Alternating Current System. Condensers have been incorporated with all fan regulators, bringing the system power factor up to .95 and sometimes to the neighbourhood of unity.

Delhi. Although the capital city of British India and fourth in order of population, the electric supply arrangements in Delhi call for little comment.

An English Company has for many years dealt with the public supply in the old city from an oil engine plant, while the requirements of the new Imperial City and the cantonments are derived from a small steam power station put down by the Government in 1925 equipped partly with old and partly with new generating plant, transmission being at 6600 volts 3-phase with distribution on the direct current system. As the aggregate generating capacity of the two undertakings is only 6000 kilowatts, it is to be regretted that no combination of interests was found possible.

Lahore. This city is now supplied by the local company on modern lines from a new Steam Turbine Station with 3-phase generation and 6000 volt underground transmission to rotary and static substations. Over 9,000 consumers are connected and the annual consumption is about 5 million units.

As Lahore is shortly destined to become the terminal station of the long distance transmission from the Mandi hydro-electric installation referred to later its supply of electrical energy appears to be well assured.

Ahmedabad. Considering its population of only 200,000 Ahmedabad may claim to be one of the most industrialised cities in India, but although it possesses nearly 100 textile mills, it is only recently that a general power supply has been seriously contemplated.

The successful local electric supply company with its Diesel driven plant has not been in a position to cater for large blocks of industrial load, and some of the more enlightened mill-owners have installed their own generating stations in order to obtain the manifold advantages of the electric drive.

Last year, however, the Ahmedabad Power Electric License was granted authorising the supply to industrial users, and it is hoped that if sufficient support is forthcoming a concrete scheme may shortly be prepared. In view of the condensed nature of the industrial area on the one hand, and the comparatively low average individual capacity of the mills, viz : 700 H.P. on the other, there is evidently an opening for a successful power undertaking.

Karachi. Although at present it stands ninth in the list of Indian cities as regards population, Karachi has a great future before it not only as a maritime but also as an air port, and the local Electric Supply Corporation has been fully alive to the necessity of providing for the future.

In 1924 a 6600 volt 3-phase power station was built alongside the old direct current plant in order to enable outlying areas to be dealt with, and several schemes are projected for throwing over the load of small private generating plants on to the public distribution system.

Diesel type prime movers are used throughout.

The fact that the supply Corporation's output has doubled in the last five years is indicative of rapid progress, and energetic management.

Cawnpore. No outstanding recent technical developments can be recorded in connection with the electric supply system of Cawnpore (which apart from the Presidency cities may be looked upon as the pioneer system in British India,

general supply having been started on Christmas day 1906), yet attention must be called to the rapidity with which demand has been fostered during the past few years by the far-sighted administration of the Cawnpore Electric Supply Corporation.

Following the laying down of a new riverside power station in 1921, the consumption of electrical energy has increased nearly fivefold, from $5\frac{1}{2}$ million units in 1922 to 27 millions in 1928, while the average receipts per unit sold have been lowered during that period from 2.62 annas to 1.26 anna. Apart from the ordinary domestic supply, cotton, flour, oil and woollen mills are the principal consumers.

Aden. Although this paper is only intended to cover the Indian Peninsula, and no attempt is made to deal with Burma and the numerous outlying Islands and Dependencies which fall within the Indian Empire, it may perhaps be permitted (as the writer had a hand in the scheme) to make reference to the electric supply undertaking at Aden, which, although 1600 miles from the Indian coast, is yet included, from an administrative point of view, in the Bombay Presidency.

This arid "Gibraltar of the East" had long craved for the amenities which electricity can provide, and under the aegis of the Settlement (or Municipality) a general supply was inaugurated in February, 1926. An installation comprising oil-fired water-tube boilers and small geared turbo-alternators arranged as a miniature replica of a large modern steam power station now supplies the Settlement and Cantonments through 6600 volt 3-phase over-head lines stepped down to 3 by 230 volts by transformers located in the bases of special transmission towers.

The undertaking secured immediate support, and the initial outlay having been cut down to a minimum, the results for 1928, the third year of working show a substantial surplus after paying all interest and sinking fund charges on a total capital expenditure of 11½ lakhs of rupees.

ELECTRICITY IN THE INDIAN STATES.

One third of the total area of India, containing a fifth of its population, is ruled over by hundreds of Indian Princes having their own internal governments.

Many of these rulers have been quick to appreciate the advantages of the use of electrical energy and possess up-to-date installations for its generation and distribution. A few recent developments may be briefly described:—

Hyderabad. The Nizam's Government early recognised the value of electricity supply in the capital city, and dealt with its initial lighting requirements by means of a small steam-driven installation located in the Mint. The demand, however, rapidly outgrew this plant, and a few years ago a new power station built on a rocky promontory in the Hussain Sagar Lake came into operation. This is equipped with "unit" coal pulverisers, water-tube boilers, and 6600 volt 3-phase turbo-alternators. The lake water is circulated for condensing purposes.

A general supply is given for public and private lighting in Hyderabad City, and also in the British Cantonment of Secunderabad a few miles away.

Although there are several other towns of importance in the Nizam's broad dominion, only one of them (Aurangabad) has yet been equipped with a general system of electrical distribution.

Indore is about to put down a new power station in the heart of the industrial area of the city in which there are nine cotton mills and sundry other industries. This will generate 3-phase energy at 6600 volts and the initial plant will be oil-engine driven on account of the difficulty in obtaining sufficient water for steam operation. Mr. Palaiet, the Minister responsible, estimates that a 10,000 k.w. plant will be necessary in a few years' time.

Travancore State has just instituted an electric supply undertaking at a cost of over Rs. 4 lakhs for supplying the capital, while four small water power plants are in operation in the tea districts.

Jaipur State in 1926 put down an up-to-date oil-engine driven power house and a complete system of underground mains in the city for street lighting and general supply.

Udaipur is about to instal a small steam power house for palace lighting and general supply.

HYDRO-ELECTRIC DEVELOPMENTS.

Mr. J. W. Meares, in the paper which he read before you in 1922, described the arduous work which had been carried out by him and his colleagues in connection with the location and assessment of the water power resources of India, and the schemes which had at that date been carried out.

Since then three outstanding projects have presented themselves for record :—

The Tata Power Company. This Company's scheme forms the third section of the development of water power in the Western Ghats for transmission to Bombay City and its environs, so courageously undertaken by the firm of Tata & Sons. The first two sections, viz : those of the Tata Hydro-Electric and the Andhra Valley Companies were dealt with in the paper presented to you by Mr. Alfred Dickinson in 1918. The triple installation is perhaps almost unique, inasmuch as energy is entirely derived from rainfall averaging 200 inches a year and stored within the actual catchment areas. Electric supply must, therefore, be sold by the kilowatt-hour as in the case of thermal power stations, whereas undertakings deriving their power from the harnessing of rivers can enter into contracts for supply on the basis of the kilowatt-year, as the flow continues whether transformed into electrical energy or not.

The combined output of the three undertakings according to the latest available figures is 280 million units per annum, and the maximum joint load so far recorded on the power houses 120,000 Kilowatts, i.e. less than two-thirds the installed plant capacity, while an annual load factor of only 25% is revealed. The Bombay mill troubles must be blamed for the poor load

factor, but it is evident that additional outlets for the power supply must be sought before this important combination is loaded up to a favourable economic level, carrying as it does an average capitalisation of about Rs.825 per kilowatt of installed generating capacity.

The salient features of the three Tata developments are as follows :—

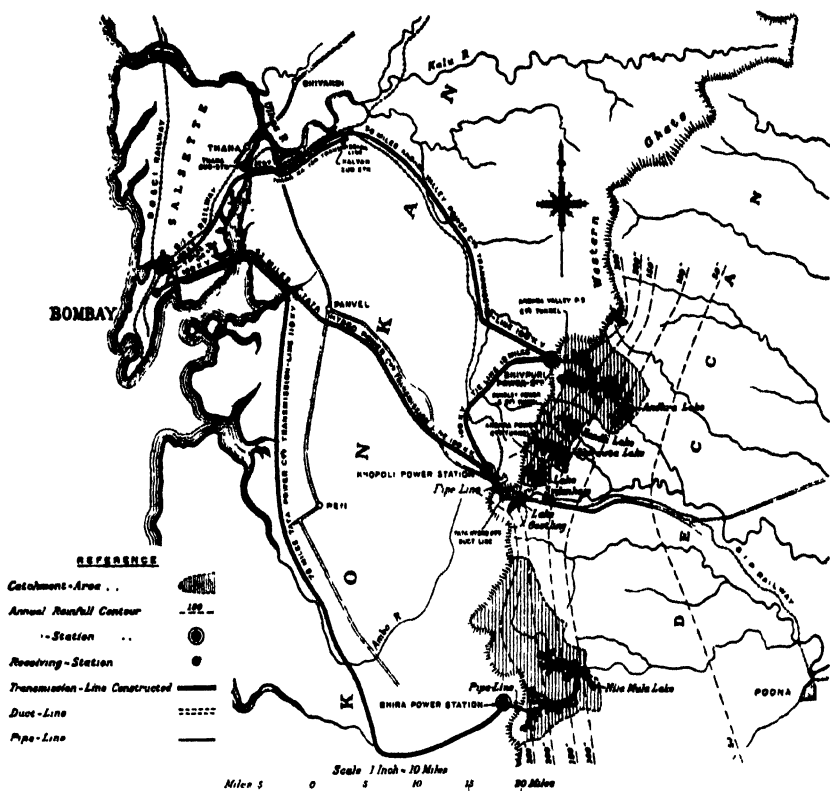
	<i>Tata Hydro-Electric Power Supply Co., Ltd.</i>	<i>Andhra Valley Supply Co., Ltd.</i>	<i>Tata Power Co., Ltd.</i>
Area of lake surface, sq miles	8.95	12.52	16
Catchment area, sq miles	21.9	48.0	112.0
Effective storage, Millions of cu. ft.	9.93	12.85	16.25
Approx. Head, feet	1,725	1,675	1,640
Power House	Khopoli	Bhivpuri	Bhira.
Total generating capacity installed	60,000 KVA say 48,000 K.W.	60,000 KVA say 48,000 K.W.	107,500 KVA say 87,500 K.W.
Length of transmission lines, miles	43.3	56.99	76.44
Receiving Stations	Parel	Dharavi	Dharavi.
Receiving Transformer capacity	70,800 KVA	63,000 KVA	108,000 KVA
Annual output, 1927- 1928, millions of units	102	103	75
Approximate total capitalisation of undertaking Rs lakhs	280	510	720
Approximate combined capitalisation per K.W. of generating plant installed—Rs 825			

Dealing with the latest development, the Tata Power Company's scheme was commenced in 1919, and came into operation the year before last.

A 150 foot dam 5000 feet long closes the outlet from a catchment valley which originally provided the sources of two rivers, and which formed a junction at the dam site. A 4000 foot approach cut and 15,000 feet of tunnel lead the water to the pipe-lines descending to a power house containing five 17,500 k.w. 11,000 volt generating units driven by double overhung Pelton wheels operating on a static head of 1,640 feet. Four 30,000 k.v.a. transformer banks step the voltage up to 110,000 for transmission over a double tower line to a receiving station at Dharavi in Bombay, where it is stepped down to 22,000 volts for underground cable distribution in conjunction with the Andhra Valley Company's supply.

The Punjab Hydro-Electric Scheme. This is usually referred to as the Mandi or Uhl River project. It was located in 1922, and after exhaustive survey, received the sanction of Government in 1925, and in the following year a new hydro-electric branch of the P.W.D. was formed under the leadership of Colonel B. C. Battye, D.S.O., to carry it out.

Staff was recruited from all parts of the world, and the development of the Power Station site has now been under construction for nearly three years,



Map of Tata Hydro-electric undertakings.

during which period 100 miles of special railway has been constructed up to the site through the beautiful Kandra valley.

It is proposed, by agreement with the Rajah of Mandi, to make use of the snow-fed waters of the river Uhl, a tributary of the Beas which it joins in the Mandi State in the hills above Simla. $2\frac{1}{2}$ miles of tunnel will lead to a pipe line falling 1800 feet to the first power station designed for 36,000 k.w. with provision for increase up to 70,000 k.w.

As soon as this load has been placed the tail race can be taken through 3 miles of duct to a second fall of 1,200 feet to a second power house for another 48,000 k.w. There is also a third fall of 750 feet which could be developed if required.

Supply over a wide area is contemplated as the following list of towns denotes :

Towns to be supplied in the First Stage. Gurdaspur ; Dhariwal ; Batala ; Amritsar ; Lahore ; Sheikhpura ; Chuharkana ; Sangla Hill ; Chak Jhumra

Lyalpur ; Kasur ; Ferozepore ; Beas ; Jullundur ; Ludhiana ; Baghbanpura ; Shahdara ; Chheharta ; Tarn Taran ; Jandiala ; and in Indian States : Mandi ; Kapurthala ; Phagwara.

Towns that can be supplied eventually. Kalka ; Simla ; Kasauli ; Sanawar ; Dharampore ; Dagshai ; Solon ; Ambala ; Patiala ; Sangrur ; Phillaur ; Sialkot ; Gujranwala ; Raewind ; Changa Manga ; Okara ; Montgomery ; Pakpattan ; Faridkot ; Kot Kapura ; Muktsar ; Fazilka ; Abohar ; Delhi ; Shahdara ; Ghaziabad ; Meerut ; Muzaffarnagar ; Roorkee ; Saharanpur ; Karnal ; Panipat ; Sonapat ; Rohtak ; Dadri ; Jind ; Bhiwani ; Hansi, and Jaranwala.

For the present, transmission will be limited to the towns in the first list with 176 miles of 132 k.v. primary transmission to Lahore and about 200 miles of 66 k.v. branch lines.

Work has been carried out at four different levels, 4,000, 6,000 and 8,000 feet above sea level on one side of a mountain, and again at 6,000 feet on the other. About six miles of local railways have been constructed at these different levels connected up by electrically operated haulage ways. A very complete and up-to-date tunnelling plant has been installed and is electrically operated throughout from two small hydro-electric developments which have been constructed one on either side of the mountain through which the hydraulic pressure tunnel is being driven. Up to the present about three-quarters of a mile of tunnel have been driven and most of the excavation work for the power station and pipe line completed.

The construction of hydraulic works in the Uhl River valley itself has only recently been started owing to the difficulties of transportation which could not be overcome until the completion of the local haulage and railway system.

Contracts for the supply and erection of pipe lines, generating plant and transmission lines to the value of upwards of one million sterling are being negotiated in London. The work has been somewhat delayed owing to the difficult nature of the country, but it is hoped that supply may be commenced about the end of 1931 or the early part of 1932.

The total initial capital outlay is put at Rs.461 lakhs (Rs.1280 per k.w. installed), and it is proposed to sell at an average all-round rate of Rs.157 per k.w. year, which at an ordinary mill load factor would be equivalent to about .75 anna per unit. If the full scheme is developed, materially lower rates are contemplated.

In addition to general electric supply to the towns scheduled, the Punjab Government anticipates that the Uhl River scheme will assist agricultural development in the province by the aid of tube-well irrigation of uncommanded land on the one hand and of drainage of water-logged areas on the other.

Madras Presidency. Estimates have recently been put forward in connection with a 40,000 Horse Power development in the Nilgiris called the Pykara-Moyar

project involving the construction of two power stations in series hydraulically and with heads of 3,250 and 1,000 feet respectively.

Three different methods of developing the catchment area have been submitted within the past year by Major H. G. Howard, M.C., Chief Engineer, Hydro-Electrical development, Madras Presidency, and have been sent on for scrutiny by the Government of India, the most promising of the three schemes having been previously examined and approved by a prominent firm of Consulting Engineers.

Although at one time a 360 mile transmission to Madras City was tentatively proposed, it is not expected that this will be considered at the outset, and it appears to be extremely unlikely that such a proposal will ever be revived.

Apart from these projects little further appears likely to be done with India's millions of water horse-power.

Hydro-electric propositions may be divided into two broad categories :—

Those involving *transmission* in bulk to one or two districts offering large demands, of which the Tata scheme is an instance, and those involving *distribution* over wide areas to scattered demands of small individual magnitude as is proposed in the Punjab.

In the first case the capital outlay per kilowatt capacity rendered **available** may be from three to five times that of a local thermal power station, and as improvements recently made and foreshadowed in steam boiler and turbine efficiencies and in the scientific treatment of coal bring the fuel portion of the cost of supply down to low levels, the disparity in capital charges will generally place the thermal station in a favourable position. Moreover, as the total cost of the supply of electrical energy, including capital charges, varies inversely as the output sold per unit of capital expended, it follows that hydro undertakings are far more sensitive financially to any declension from the ideal conditions of operation, viz : those of continuous output at the maximum capacity for which they have been equipped.

Turning to the second category, that of long distance *distribution*, the heavy cost of tapping high voltage lines creates a serious financial handicap. For lines of 100,000 volts and upwards, the cost in the present state of the art is more or less fixed irrespective of the demand to be fed, and if all proper safeguards are taken, is probably in the neighbourhood of Rs.2 to Rs.3 lakhs per tapping, a very heavy initial outlay in respect of supply to a small town or community.

Furthermore, reliability and stability factors enter prominently into the question of long distance transmission and distribution, while the difficulty of effecting adequate inspection patrol is emphasised under Indian conditions.

Except in specially favourable cases, therefore, it is to be feared that the results of the work of the surveyors of the water power resources of India are likely long to remain of academic interest only.

INDUSTRIAL ELECTRICAL DEVELOPMENTS.

The great sub-continent of India, which is larger than Europe without Russia, has diametrically opposite labour characteristics from those with which we are accustomed at home, inasmuch as the lure of the country rather than that of the city is predominant among its population.

Accommodating a fifth of the human race with three-quarters of its inhabitants devoted to the cultivation of the soil, less than 10 per cent. of whom are literate, with its hundred languages and thousand dialects, India has been described by a great journalist as an ocean of all-pervading agriculture studded with a few widely scattered industrial islands.

This description may be emphasised by recording that India has only 33 cities with a population of over 100,000, few of which may be characterised as industrial in the Western sense, but that it possesses 700,000 villages, in which cottage industries are carried on during the periods of enforced agricultural idleness imposed by seasonal conditions.

Parallel with these handicrafts, however, there has been a steady growth in mechanical industrialism in which electricity plays such a dominant part, but, as already stated, it is so far limited to a few manufacturing centres.

One of our leading contractors with wide interests once told the writer that he always employed the same unit figures for labour plus supervision, which he claimed cost the same the world over, but owing to the intermittent indulgences in manual labour, other than agriculture, which the Indian has until recently allowed himself, to his consequent detriment from the industrial employers' point of view, these standard costs would probably be found to be on the low side if applied to Indian conditions. For this reason and owing to the difficulty of obtaining even indifferent labour adequate to the needs of India's industrial islands, the use of electrical energy has become almost a vital necessity for their economic welfare and existence.

Outside the chief centres of population, which have already been dealt with, there are a few instances in which local conditions with regard to raw material have led to the establishment of isolated cases of mechanised industry, the outstanding example of which is:—

The Tata Iron and Steel Company Situated at Jamshedpur about 150 miles to the west of Calcutta, and built upon a site on which 20 years ago stood the village of Sakchi in the primeval jungle, the works of this important company are electrically self-contained and own two steam power stations, having capacities of 11,750 and 25,000 k.w. respectively. An 18,000 k.w. set is shortly to be installed in the larger station, and the smaller will then be shut down, leaving a single station of 38,000 k.w. capacity.

Power is transmitted overhead at 3,000 volts 3-phase, 50 cycles, and is used for many purposes in the manufacture and refining of steel. The annual demand is 150 million units a year, about the same as that of the whole of the City of Calcutta. Over 100,000 h.p. of motors are installed, the largest

being 6,500 h.p. About one-third of this horse power consists of direct current motors, for speed control reasons, the conversion from alternating current being carried out by fly-wheel motor-generators in the case of supply to the large reversing mills, and by ordinary motor generators for the smaller motor circuits, the latter being arranged to operate as 80 per cent. leading power factor in order to correct the alternating current system. The latest addition to the Steel Company's electrical plant is that required for a new reversing roughing mill and consists of a 4,000 h.p. direct current slow speed reversing motor with a 3,800 K.W. flywheel motor-generator set, the latter being fitted with a 33-ton flywheel constructed from three steel plates, 13ft. 6in. diameter, and each over four inches thick.

Bundi Portland Cement Co., Ltd. The works of this Company, situated at Lakheri, are completely electrified, and important additions have recently been made. About 7,000 K.W. of 500-volt 3-phase generating plant is installed and distribution is carried out underground, outlying departments being fed at 3,300 and 6,600 volts via step-up and step-down transformer banks, some of the larger motors, however, being operated direct at 3,300 volts.

Nearly 100 motors of various sizes are used (the smaller, in view of the working conditions, being totally enclosed), while electrical energy is used for testing apparatus, welding, and for laboratory furnaces.

Colliery Electrification The application of Electricity to Coal Mining in India is slowly gaining ground, as is shown in the following official statistics of Electric Motors installed :—

	1924.	1925.	1926.	1927.
H.P. on surface ...	13,564	15,501	16,192	16,440
H.P. below ground ...	29,938	36,835	38,356	43,099
Total H.P. ...	43,502	52,336	54,548	59,539

The use of electrically driven coal cutters has not been developed to any great extent, the number in use having only increased from 109 in 1924 to 124 in 1927, about equal numbers of the American chain and the British bar type being employed.

Although many Indian coal mines have their own power plants, Colliery Supply undertakings have been formed in certain areas, recent examples being as follows :—

Name of Undertaking.	Dishergarh Power Supply Co	Associated Power Co	Sijua (Jharia) Electric Supply Co	East Indian Railway Co.
Coalfield	Raniganj	Raniganj	Jharia	Giridih.
Number of Collieries supplied	19	11	16	Several
Total plant capacity K.W.	8,000	1,750	8,000	2,450
Transmission voltage ...	11,000	3,300	6,600	2,200
Total connected load H.P.	9,807	4,550	10,034	3,414

ELECTRIC TRACTION.

Electric Tramways have been in operation in the principal cities of India for many years, but the application of electric traction to railways has been somewhat backward, for although the electrification of the suburban sections of the two railways running out of Bombay City was investigated as far back as 1912, it was not until 1922 that sanction was given to the first electrification scheme, that of the suburban section of the G.I.P. Railway over which the first electric trains were run in February 1925. In September of that year the Indian Railway Board sanctioned the electrification of the main line routes on that Railway out as far as Igatpuri and Poona, thus making, with the suburban section, a total of about 300 miles of electrified track.

In 1923 sanction was given in connection with the suburban section of the B.B. and C.I. Railway out as far as Borivli, but owing mainly to the coal strike in this country it was not until January of last year that the electrified service came into operation.

In the early days of railway electrification several different systems of electrical transmission, collection, and utilisation were installed in Europe and the Americas, and for many years what was then referred to as the "battle of the systems" was fiercely fought. In one case just prior to the war, five different propositions were put forward by manufacturers in connection with the electrification of an important mineral line.

Realising the necessity for a measure of standardisation the British Government in 1920 appointed an Advisory Committee upon the Electrification of Railways, and their report published in 1921 as revised last year lays down as standards generation and transmission on the 3-phase 50 cycle alternating current system, and transformation to 1,500 volts direct current for use on the tracks, with collection from an overhead conductor.

As this standard system was decided upon as far back as 1912 by the two railway companies operating the suburban lines running out of Bombay city, (overhead conductors being then chosen mainly on account of track flooding difficulties and incidentally of the tendency of Indians to trespass on the lines) its choice gives evidence of the foresight of their consulting engineers, Messrs. Merz and Partners.

Descriptions of the Bombay electrification scheme have been so widely published that only broad details need be recorded. 3-phase electrical energy is taken from the Tata group of Hydro-Electric Companies, and is generated in the Ghats 60/70 miles inland and transmitted overhead at 90/100,000 volts to receiving stations in the neighbourhood of Bombay City, where it is stepped down to 22,000 volts for retransmission partly overhead and partly underground to rotary substations at strategic points alongside the railway tracks. At these substations it is converted to 1,500 volts direct current for use on the overhead conductor system, the ordinary rails suitably bonded acting as the return circuit.

In the case of the B.B. and C.I. suburban section, the sub-stations, three in number and having a total capacity of 20,000 k.w. are of the supervisory controlled type, manual operation being entirely dispensed with, and all high and low pressure switching being dealt with from a single central control office.

The control is effected with the aid of apparatus similar to that used in automatic telephone exchanges, selectors being employed to transmit low voltage impulses over 3 core pilot cables to similar selectors in the substations. These selectors bring relays into action, which prepare the switchgear for the selected operation and then transmit a signal back notifying that the selection has been made. A push button at the control office then enables the operation to be carried out, after which a second and confirmatory signal is transmitted, indicating that it has been completed. The whole sequence takes about 3 seconds.

In the case of the G.I.P. suburban sections the substations are arranged for manual operation, with, however, automatic features in certain cases.

The overhead equipment consists of a trolley wire with catenary suspension carried on lattice steel structures having a normal spacing of 220 feet, the total copper section being .625 sq. inch on each track.

For suburban service on both railways all-steel rolling stock units, consisting of one motor and three trailer coaches, are used, and preparation was made for the new stock to have an overall width of 12 feet as compared with the then existing standard maxima of 10ft. bins. for four-wheeled stock and 10ft. oins. for bogie stock. The overall length of the coaches is 68 feet, and when equipped for third class they accommodate 120 passengers each, i.e., nearly 1,000 passengers in a two-unit train consisting of eight coaches.

The normal maximum running speed of the suburban trains is 48 m.p.h.

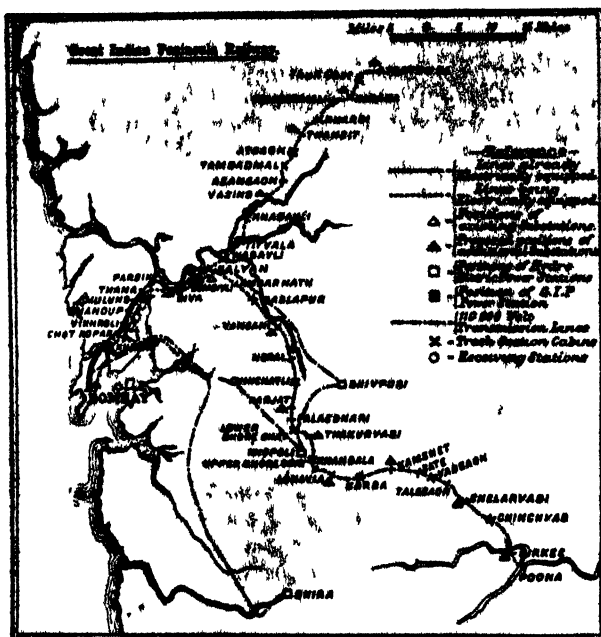
As regards the effect of this electrification, to quote the Report of the Railway Board: "These services have become highly popular and promise to be entirely successful."

With regard to the main line electrification of the G.I.P. Railway from Bombay to Igatpuri and Poona via the Ghats where the maximum ruling grade is 1 in 37, special high speed locomotives will be used for drawing the ordinary rolling stock.

Over a few miles the railway mounts more than 2,000 feet, and the tractive conditions are, therefore, specially arduous, and when coupled with the exacting climatic conditions of high temperature, torrential rainfall and liability to track flooding, the greatest care upon the part of the Consulting Engineers and the manufacturers has been called for in deciding upon a suitable design.

After consideration of different British and Continental designs, three sample locomotives were ordered from different manufacturers, and after trials and tests, twenty-one passenger and forty-one freight locomotives were ordered from the Metropolitan-Vickers Company. Brief details of these two types are as follows:—

		Passenger.	Freight.
Overall length ...	66 feet	66 feet	
Total weight	100 tons	120 tons	
Adhesive weight ...	60 tons	120 tons	
Maximum Service Speed	75 m p h	45 m p h.	
Motors	6 of 360 h p.	4 of 650 h.p.	



Map shewing electrification of G.I.P. Railway.

It is intended that some of the freight locomotives shall act as banking engines to assist the passenger type when negotiating the heavy grade sections on the Ghats, and the characteristics of the two types are such that they will operate and share the load satisfactorily together. All are arranged for regenerative electric-breaking, i.e. when descending the steep gradient they will return energy to the system, and it is anticipated that their operation, coupled with the elimination of the present reversing stations rendered possible with electric traction, will reduce the running time between Bombay and Poona (119 miles) from over 4 hours to under 3 hours.

The overhead equipment on the mountain sections of the mail line possesses novel features as, in view of the heavy currents to be dealt with, a total section of 1 square inch of copper is carried above each track divided between a main

catenary (.5 square inch), an auxiliary catenary (.2 square inch) and the trolley wire (.3 square inch). The main catenary is supported at 220ft intervals as in the case of the suburban sections.

The whole of the power for the operation of the two Ghats sections of the G.I.P. Railway will be drawn from a thermal power station now under construction at Kalyan. This will be equipped with four 10,000 Kilowatt generating units and six stoker-fired boilers arranged for 270 lbs. steam pressure, 725° Fahrenheit total steam temperature and fitted with oil firing equipment for overload forcing purposes.

Generation will be at 6,600 volts 3-phase 50 cycles stepping up to 95,000 volts for transmission to eleven rotary substations, some arranged for manual, others for supervisory remote control.

Work on this important main line electrification is well advanced, and it is hoped that electrical operation will come into force on the Poona section during the coming summer, and on the Igatpuri section during next year.

With regard to other Indian Railways, the electrification of the suburban section of the South Indian between Madras Beach and Tambaram has been sanctioned, and propositions in respect of certain main line sections of that Railway have been put forward, but so far no decision has been arrived at.

With regard to the Calcutta suburban lines, electrification has been considered, but in view of the heavy expenditure involved the matter has been referred back for further investigation.

SPECIAL APPLICATION OF ELECTRICITY TO STEAM RAILWAY REQUIREMENTS.

For many years progressive use of electricity has been made by the Railways of India for train lighting, workshop driving, welding, pumping, crane and capstan operation and so forth, and perhaps the only recent application which, in view of its interesting nature, calls for record, is the general application of electric headlights to steam locomotives.

About 85 per cent. of the steam locomotives have so far been fitted, and the Railway Board are considering the advisability of making such headlights compulsory.

The generator for the supply of the electrical energy must, of necessity, be located on the locomotive itself, and it takes the form of a 32 volt 500 watt steam turbine-driven set which is bracketed off the side of the boiler casing. There are several types with both alternating and direct current generators, but the British product introduced a couple of years ago is a turbo-alternator of outstanding simplicity.

A single wheel steam turbine drives an inductor type of alternator, having a toothed rotor without windings of any sort and a stator consisting of permanent magnets with laminated pole-tips carrying only two small fixed coils embedded therein. There is consequently no commutator or collector. The permanent

magnets require remagnetising at infrequent intervals but electro-magnets are provided for this purpose as part of the standard equipment.

Only 250 watts, i.e. half the output of the turbo-alternator, is taken by the actual headlight, the other half being applied for lighting the cab, gauges, lubricators and tender, while a portable lamp can be plugged in for inspection purposes.

BROADCASTING.

Concluding with this latest example of electrical application, wireless broadcasting on the lines of the B.B.C. came into operation in 1927 through the medium of stations in Calcutta 7CA (370.4 metres) and Bombay VIIB (357.1 metres) operated by the Indian Broadcasting Company, a subsidiary of the Indian Radio Telegraph Company. These stations although of the same transmitting power as 2LO, viz : 3 kilowatts, have been found under Indian climatic conditions to possess much greater transmitting ranges, and regular reception is reported from the North-West provinces, from Ceylon, and even from the Malay States 1,800 miles away. Fading, which is not usual with 2LO, is, however, very pronounced at times.

So far broadcasting has not captured the imagination of the Indian public to a degree sufficient to make it a financial success, but the Company are of the opinion that if they are patient and keep a good service going they will eventually obtain the necessary number of license holders, which is at present less than 10,000. Should financial success be ultimately achieved, additional transmitting stations will no doubt be installed at such centres as Delhi and Madras.

I wish to record my grateful appreciation for the full information so readily given me by many friends, firms and officials, both in India and this country and from which I have been forced to make a very condensed selection.

My thanks are also due to the following firms for the loan of photographs and lantern slides : British Thomson-Houston Co., Ltd. ; British Insulated Cables Co. ; Callender's Cable & Construction Co. ; Cammell, Laird & Co. ; English Electric Co. ; General Electric Co. ; Metropolitan Vickers ; J. Stone & Co., Ltd., and " The Times of India."

DISCUSSION.

MR. J. W. MEARES, C.I.E., M.Inst.C.E., M.I.E.E., as one of the pioneers in India of the electrical industry, was very glad to have been present at the reading of this very opportune paper. He said that because, after what Mr. Cooper had told them, they would be a little amused to hear what was said recently in an important publication by the World Power Conference. That important international body issued a report on the power resources of the world, and after enumerating the countries where a first approximation had been made towards the assessment of water power resources, it stated that the rest of the world

remained to be examined right from the beginning. The rest of the world included India. Mr. Cooper had told them about the three actually working Tata schemes—schemes of enormous importance and the only ones of their sort in the world dealing with stored water pure and simple with no river flowing through them—and other schemes which were coming on, which might or might not be successful, hereafter. Speaking of world power production, the same document said later on: "In Asia, India, China and Siberia remain to be exploited." China and Siberia, it would be noted, were coupled with the Indian Empire, which had been in many ways a pioneer, and had certainly put forward extraordinarily good work.

One could not but notice, to Mr. Cooper's entire credit, that, unlike most officials, he had evidently not had much to do with hill stations in India. Some of them, on the other hand, had spent as officials an undue proportion of their time there. In the table dealing with automatic telephony Simla, which, he thought he was right in saying, had the first automatic telephone system in India, was not mentioned, while Darjeeling had the first hydro-electric scheme. It was put in by himself, so he knew that it was the first. It was a small scheme. It had been followed by quite a number of other schemes in the hill stations scattered over India, and those schemes, though small in their way, were of considerable importance and highly successful. There was no question that sooner or later the hill railways would have to be electrified. There was water power on the spot in almost every case.

As a matter of history, when he went to India in 1896 the only public lighting installation, so far as he knew, was in the Eden Gardens, Calcutta, and it consisted of Jablokhoff candles. That system came into use in the seventies, and disappeared from the face of the world elsewhere in the eighties, but was still working in Calcutta in 1896. When he suggested that modern lighting should replace those candles the Bengal Government said, "What is the matter with them? They have been working for thirty years, and will go on working for a long time. Why replace them?" It was found afterwards that those candles cost three times as much per annum as the whole power upkeep of the modern lamps which replaced them. That was a rather good lesson to Governments bent on economy in capital expenditure and squandering money regardlessly on maintenance.

Another small point he noticed was that the Cauvery scheme, which was the first hydro-electric scheme in a native State in India, was not among those mentioned in the paper, though it was a scheme of great importance to the goldfields in the State, and had done extraordinarily well. At the other end of the scale the Kashmir scheme, which had done very badly, was also not included.

The lecturer did not seem to think that the work of the hydro-electric survey would come to much. In inaugurating that survey, Sir Thomas Holland looked a long way ahead. The work done remained on record, the sites were known, and to a certain extent investigated, and he thought there would be openings for them. He would like in particular to mention the wonderful work that Sir Gunga Ram did in the Punjab with his little hydro-electric scheme for irrigation by pumping. That was an application of electricity which made use of water power from the local canals, and had immense possibilities in the irrigation of the "uncommanded" areas above the canals. Sir Gunga Ram had shown the way, and that there was a future for such a development he (the speaker) felt certain. The only possible thing against it was that the same thing could be done by the "hydraulomat," a purely mechanical apparatus, which was being installed in quite a number of places in the Punjab.

Turning again to water power, he agreed with Mr. Cooper regarding the distinction between the hydro-electric station supplying bulk power in an industrial area and the stations with a supply spread over a very large area. He must confess to the gravest doubts whether it would ever be possible to make a profit on the Punjab scheme because of the enormous number of small places which would have to be tapped by lines of moderate pressure. The capital cost would, he thought, be prohibitive. There was still a use, however, for the larger station transmitting to industrial areas. Such areas might not exist at the moment, but where power was available industry often followed.

Mr. G. B. GILL (Messrs Merz and Partners) said that Mr. Cooper had mentioned that some direct current extensions with rotary converters were being installed in Bombay and Calcutta. He would like to ask whether that development had Mr. Cooper's approval, seeing that it was more usual nowadays to extend with alternating current. Had the Indian Government any powers with regard to electricity supply? From the particulars given in the paper, it appeared that development was taking place on English standard lines. This was important, as English manufacturers could take a large share in the four million pounds which Mr. Cooper stated to be spent annually by India on imports of electrical apparatus, machinery and accessories. Incidentally, if English standards were employed, care must be taken in the selection of distribution voltage, remembering that Indians often worked barefoot.

With regard to the details of the electrification work in Bombay, perhaps Mr. Cooper would permit him to amplify some of the information given in the paper. When the electrified service first started, a considerable amount of trouble was caused by that well-known bird, the Bombay crow. This crow liked, if possible, to build his nest of wire and often selected the overhead equipment structures as nesting-places. When carrying wires about, they were often dropped on the overhead equipment. The results were somewhat spectacular and the railway service was considerably interfered with, the overhead equipment wires in some cases being burned through. Eventually a somewhat expensive system of guards had been devised, though this was not completely effective, and he thought that a certain amount of trouble from the crow would always have to be legislated for. Thieves also caused trouble. In one case the copper bonding of the rails disappeared the day after it was put down, and in another case when a small section of transmission line which had been out of use for some time came to be switched on it was found that the wires were missing.

A picture of a train running through floods had appeared on the screen. It might be interesting to know that those floods were sometimes three feet deep; but even at that depth the motors had hitherto functioned very successfully. In one train unit of four coaches the motor and coaches were so arranged that two coaches were pushed in one direction and hauled in the other. There had been no trouble at all with that method of traction. On the suburban section in Bombay the traction system was just about complete, and running would start very shortly. The goods yards were now being worked electrically.

On the main line extension up to Igatpuri and Poona there would be eleven sub-stations, each with two or three sets of 2,500 kilowatts. Five of the eleven would be attended and six unattended; an unattended sub-station would be controlled from an adjacent attended sub-station. That helped to cut down the running expenses considerably. The duplicate 100,000-volt transmission lines which followed the railway route had no special features, but on the Ghats section

towards Poona, where there was a rise of practically 2,000 feet, maintenance conditions during the monsoon were very difficult, with seven or eight inches of rain a day. On this section, therefore, which was more liable to trouble than any other, a third transmission line had been put up which could be switched in if conditions warranted it.

The Calcutta electrification scheme was given comparatively few lines in the paper, but he thought that more would be heard of it fairly soon. There were difficulties there which were partly financial and partly engineering. For a sound engineering scheme, however, it was necessary that the two main terminal stations in Calcutta should have a direct rail connection. This necessitated either a railway bridge over the river or a tube railway. The problems involved were under close consideration.

It was his experience that there was a considerable shortage of Indian artisans for electrical work, though there were a certain number of good men available. The present arrangements for educating these men seemed to be a little wanting. The Indian training colleges were doing good work, but he thought that Indians were not being turned out in the way they ought to be for the erection and maintenance work of electrical equipment. Far too often English manufacturers had to send out their own workmen to do work which should be done by Indians. The Indians who came to this country for training were not of the class that worked with their hands when they returned to their own country. The general question of training workmen was a point which the Government ought to look into in order that men could be trained so as to keep pace with electrical progress in India.

THE CHAIRMAN thought that the reason why the schemes referred to by Mr. Meares were not mentioned in the paper was contained in the first word of the title, "Recent," which Mr. Meares seemed to have overlooked. As to the automatic telephone at Simla, of which he had had experience, possibly the lecturer had not mentioned it because the Royal Society of Arts was rather particular about the language used in their hall.

He claimed to speak with some authority on hydro-electric development, as he had had some experience, first of all as a Director of a great hydro-electric company; secondly, from association with a company that used hydro-electric power in bulk; and, thirdly, as one who tried to sell it. To him Mr. Cooper's paper was of extraordinary interest, not only for what was actually said in it, but for the lines of thought it suggested.

The paper referred to the comparatively low consumption of electrical energy per head in India. That seemed to him to arise in the main because only one company in the whole of India, so far as he knew, had ever attempted to sell electricity, though a large number of companies supplied it; but supplying and selling were as wide as the Poles asunder, and experience showed that if the question of selling was systematically dealt with, the Indian market, certainly in the great centres of population, was likely to be just as receptive of electrical and mechanical energy as that of any country in the West. That was one more example of the unmitigated nonsense of contending that the Indian community did not respond readily to modern conveniences and facilities.

A very valuable portion of the paper was that in which the lecturer suggested, rather than said, that very careful consideration was necessary before gigantic sums were spent on hydro-electric schemes. After the war people had water on the brain. Speaking from some experience, although in theory water power ought to be and might be cheap, in some cases it was dearer by nearly one-third than

thermal power. Apart from that, painful experience had shown directors and shareholders how great was the capital charge of hydro-electric works before a single unit could be sold, to say nothing of working to capacity.

He believed that they were on the verge of a great development of thermal efficiency through high pressures and the pre-treatment of coal, and that necessitated intensive consideration before colossal sums were embarked in hydro-electric power schemes. He ventured to invite attention to this consideration specifically, because the lecturer had given figures showing the estimated selling rate of electrical energy from particular hydraulic works. If any of those present were engaged in such projects he would say to them, "If you think you are going to sell electrical energy in bulk or to retail it in large quantities for domestic purposes at a higher rate than .5 anna per unit, you are making a mistake which will have disastrous effects upon your own pockets and upon the fortunes of those who are foolish enough to trust you."

A careful study of the paper would show that Mr. Cooper had indicated lines of thought of profound significance to those engaged in electrical development in India, and he would like to express his personal gratitude to Mr. Cooper for the lucidity and care with which the facts were put forward.

He had a train to catch, and perhaps those present would excuse him. He would ask Sir Charles Armstrong to take the Chair.

(Sir Charles Armstrong accordingly took the Chair.)

MR. H. R. BHATTIA asked what was the lecturer's view regarding the transmission voltage adopted by the Punjab hydro-electric scheme. Compared with long-distance transmission lines elsewhere, it would seem that a higher transmission voltage would be justified. Would Mr. Cooper also give information as to how many units were proposed to be installed in that scheme?

Regarding the third section of the Tata Power Company, he understood that the construction of that section was embarked upon in view of the demands of electrification schemes undertaken by the suburban railway companies of Bombay. The latter were now erecting their own power plants. Did the lecturer think that the Tata Power Company would be able to secure more demand for this power house?

MR. J. G. GRIFFIN agreed generally with what was said in the paper about the supply of hydro-electric power. A point that appealed to him very strongly was that with long transmission lines, some of them going over wide rivers and across comparatively inaccessible places, there was the possibility of a failure of supply owing to political troubles, or even individual miscreants.

In regard to thermal stations, Mr. Cooper had not referred at all to Diesel engines; there were several successful Diesel power stations in India. There was a very large field in India for the supply of cheap electricity. Small electrical stations could be put down comparatively cheaply, and if the organisation was properly arranged and the right methods adopted, he believed that an electricity supply could be profitably installed and run in a considerable number of the smaller towns.

MR. A. T. COOPER, in reply, explained that his paper was more or less an historical survey of Indian electrical progress during the last five or six years, and naturally did not call for very much in the way of discussion in the ordinary sense of the term. He was, however, very gratified at the interesting comments it had evoked.

In reply to Mr. Bhatia's question about the voltage of 132,000 selected by the promoters of the Punjab scheme, he was afraid he did not know why that particular voltage was pitched upon; but it happened to coincide with that used in connection with the British "Grid," for which equipment was being more or less standardised. Considering the transmission distances ultimately involved (Delhi being something like 400 miles away), the voltage did appear low, although the old rough rule of "1,000 volts per mile, plus 1,000 volts for luck," had long since gone by the board.

With regard to Mr. Bhatia's pertinent query as to whether the Tata Power Company would be able to secure sufficient demand to load up their new power house, this appeared to be entirely in their own hands and depended upon the rate at which they were prepared to sell, and as to how far they could meet the decreasing costs of thermal generation.

Mr. Meares rather reproached him for not mentioning some of the earlier electrical schemes in India. The paper dealt only with progress during the last five or six years, and he pointed out that Mr. Meares himself had already discussed those early schemes in a paper read in 1922.

Mr. Gill had very kindly amplified the details of the G.I.P. electrification and had asked a question regarding the extension of direct current areas by some of the Supply Authorities in India. Most of those Authorities, including the three Presidency Cities of Madras, Calcutta and Bombay, started in the early days of electricity supply, when everything was on direct current lines. As time went on, the advantages and flexibility of alternating current generation and distribution came to be recognised, and in all those three cities, he thought—he he knew it was so in the case of Bombay because he carried it out himself—a cordon was put round the original direct current area, and it was said, "Thus far and no further." All the outskirts were dealt with on alternating current lines. The advisability of changing over those direct current areas to alternating current in order to make the supply homogeneous had been considered; but with Indian distribution it was a much more expensive matter than in this country because of the enormous number of fans.

Mr. Gill had also raised a point with regard to Government control of electricity supply. The Indian Electricity Law was modelled on British lines with, however, thanks to Mr. Meares, considerable improvements in several respects, and as most electrical developments in India were carried out under home guidance, British standards of voltage and frequency were being generally followed. As regards the risk of shock he did not think that an Indian with thick-skinned bare feet was in any more danger than a tender-footed European in wet shoes!

Mr. Griffin had complained of the absence of reference to Diesel engines, but he had recorded the use in most of the smaller cities of oil-engine driven installations.

From his knowledge of costs of production with the latest types of oil-engines he agreed with Mr. Griffin that their use for small electric supply installations was fully justified. Where the dividing line lay between oil-engines and steam turbines it was difficult to say, as it depended so much upon local conditions both initial and potential, but he felt confident that in most cases the two thermal methods of generation could hold their own against all but the most favoured hydro-electric propositions.

As Thomas Edison recently said: "A great deal more fuss is being made over hydro-electric power than its intrinsic value warrants."

He was very grateful for the kind words used by Sir Stanley Reed in his comments on the paper, the preparation of which had given him a great deal of pleasure.

THE CHAIRMAN (SIR CHARLES ARMSTRONG), in moving a very cordial vote of thanks to Mr. Cooper for his comprehensive and interesting paper, said that Mr. Cooper and he were both Bombay men, and had been interested a good many years in the same electrical concern—the Bombay Tramways Company. Twenty-five years ago the then Managing Director had shown him round a new power station which had just been erected and was the very latest thing in electrical development. Ten or twelve years later, as he gathered from Mr. Cooper, that power station was more or less closed down, and the power was taken thereafter from the Tata Hydro-electric Company.

His own interest in electrical development in India had been rather more recent than that, because he happened to be Chairman of the Great Indian Peninsula Railway when the work of electrification was going on. Before the work was completed, however, the Government of India took the railway over, and he had not seen the actual electrical working of the suburban traffic; but the work was being carried on during the few years that he was Chairman. It was a very big piece of work and a very necessary one, because it was the only way of dealing with the very dense population of Bombay and of enabling them to live outside the island. Electricity brought many improvements into India. It gave Bombay electric trams and electric fans. He could not say that he liked the latter, but some people liked them very much.

He was very much obliged, and he felt sure that everyone present was very much obliged, to Mr. Cooper for his most excellent paper.

The vote of thanks having been carried unanimously, the meeting terminated.

COLONEL AUBREY O'BRIEN, C.I.E., C.B.E., writes :-

Mr. Cooper, in his interesting paper, sounds the necessary note of alarm with reference to the Punjab Hydro-Electric scheme, of which the first stage is now well advanced. The capital expenditure will be very great, over 4½ crores for the production of the first 36,000 kws., and it is essential that the supply available should be quickly taken up. The cost of tapping the main transmission line also necessitates that any town which takes power should be quickly assured of a brisk consumption. To counter this, the Hydro-Electric branch in estimating probable consumption has only taken into consideration the industrial demand, whereas, if power is really to be of use to an agricultural province like the Punjab, it must be used, wherever possible, as an assistance to agriculture. The Punjab peoples are enterprising and quick to take up mechanical devices, but they will require continuous propaganda and education in a science entirely new to India. They will have to be taught all that is known in the countries which already harness electricity to the needs of agriculture, so that the period of discovery of those uses which are suitable to the Punjab may be cut down as much as possible. Fortunately, cultivated fields and gardens touch and even intermingle with the houses of the biggest cities, and, though holdings are small, the Co-operative Societies are more advanced in the Punjab than in any other province of India.

The greatest assistance that can be given to agriculture in the Punjab is the provision of water, and here it has been calculated that electro-pumping could add 6,000 cusecs. to the visible flow supply, the equivalent of adding another river to the province. Two and a half million acres of land now dependent on rain might be annually irrigated, while land, now waterlogged, or threatened with waterlogging, could be saved and the water sent on to thirsty country elsewhere. There are difficulties in this connection, difficulties with regard to the right type

of tube wells, but especially with regard to the charges for the water supplied. Canal water has been steadily cheapened in recent years, and, although the profit from the land would amply cover the cost of pumped water, people will have to be educated up to paying for it, especially those who, for the cure of waterlogging, must rightly have their canal water taken from them.

If long distance distribution is to pay anywhere, the Punjab is best situated for the experiment. Bengal coal is about one thousand miles away, and though there is a small supply of oil at Khaur, near Rawalpindi, the price has been assimilated to world prices, raised high for India. Mr. Cooper's note with regard to reliability and adequate inspection patrol is of importance, for an interruption would be disastrous during the furnace heat of the Punjab summer, but the main line and principal branches would be easily supervised, and the communications of the province are on the whole good.

OBITUARY.

MR. L. B. KEYSER.--We regret to announce the death of Mr. Leonard Bethell Keyser, which took place recently at his Winchester home, in his 73rd year. He was the youngest son of Mr. Alfred Keyser, of Cross Oak, Berkhamstead, and was educated at Clifton. He was closely associated with Winchester for the last 28 years of his life, becoming Secretary of the Hampshire Club in 1901 and a leader in many local public activities. In 1913 he was appointed honorary treasurer of the Royal Hampshire County Hospital, and his many valuable services to the hospital included the establishment of a contributory scheme, under which voluntary contributions gave contributors a right to hospital treatment. This reform—introduced here for the first time in connection with a provincial hospital

has been strikingly successful, and contributors to the scheme now number over 30,000, and the finances of the hospital have been much benefited. In his youth Leonard Keyser was a fine Association football player, and in later life he became a keen golfer; he was also one of the oldest members of the M.C.C. He had been a member of the Royal Society of Arts for nearly 50 years, having been elected in 1880.

NOTES ON BOOKS.

EARLY CHURCH ART IN NORTHERN EUROPE. With special reference to Timber Construction and Decoration. By J. Strzygowski. London: B. T. Batsford, Ltd. 21s.

One of the most exciting "ifs" in history is this. What would have happened if King Harold, in the celebrated year 1066, had been beaten by Harald Hardrada, and if William of Normandy had then met not Harold but Harald, and had also been beaten by him? Those children and adults for whom history is only a subject taught at school may remain under the impression that Hardrada and his people were a sort of barbarians; they were, of course, nothing of the kind, but a civilised race with art as well as enterprise to their credit; and it is possible that they were the first, therefore the real, discoverers of America.

Professor Strzygowski complains, not that people are unwilling to discuss "what would have happened if—," but that they shut their eyes to events which did occur, and which have left traces that can be examined. Thus architecture, he alleges, is regarded as forming one main stream from classical times, no allowance being made for tributaries. In this book he shows that timber construction in Northern Europe has in the past been referable to intelligible and intelligent native principles unaffected by the classical tradition.

"During the dark ages," says Professor Strzygowski, "we are not at the beginning but at the end of a flourishing northern art," an art which penetrated as far south as the coast of Dalmatia and Spain. Before the Romanesque style gained its supremacy the native architects of Western Europe were building in wood framework, those of Eastern Europe in wood blockwork, those of Northern Europe in wood stavework, or "mastwork," as Professor Strzygowski calls it. Wood is, unfortunately, very perishable, and as the Northern architects, whether in Norway or Dalmatia, only began to translate their ideas into stone round about the time when the Romanesque style was capturing the European imagination, there are not a great many examples of this early church art left standing. But there are a sufficient number for purposes of study, and the case that Professor Strzygowski is able to make is a very convincing one.

To us chapter III is likely to be of especial interest, since it deals with half-timber churches, more than half of the illustrations being drawn from England. If modern half-timber is an affectation rising out of an ill-developed appreciation of the picturesque, ancient half-timber sprang from necessity: "Western Europe from Roman times was not rich enough in forests to provide wood for the full-timber building of earlier ages, which in Russia and still more in Finland has continued down to the present day. . . . Our surviving half-timber churches are sometimes as attractive as they are interesting, but the tower of Earl's Barton, reproduced as Plate XXXV, is such an interesting example of stone arranged so as to suggest woodwork that one hardly can bring oneself to consider its independent æsthetic merits.

Professor Strzygowski knows too much for it to be easy for him to compress any part of his knowledge into a small book, but this is only another way of saying that we can only seldom hope to get so much, of such quality, *in parvo*.

P.B.

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

- MONDAY, JUNE 10.** Anthroposophical Society, at the Royal Society of Arts, Adelphi, W.C. 8.15 p.m. M. Ehrenfried Pfeiffer, "The Influence of Man on Crystallisation and on the Growth of Plants."
Anthropological Society, 35, Upper Bedford Place, W.C. 8.30 p.m. Miss J. Gaultier de la Verindrv, "Folk Songs of Canada, Eskimo, Indian and French-Canadian."
British Architects, Royal Institute of, 9, Conduit Street, W. 8 p.m. Business Meeting.
Geographical Society, at the Aeonian Hall, New Bond Street, W. Mr. Leonard T. Scott, "The Sauria Oases and the Niger from Timbuktu to Jebel."
University of London, at King's College, Strand, W.C. 5.30 p.m. Dr. H. Wildon Carr, "The Philosophy of Leibniz." (Lecture II.)
- TUESDAY, JUNE 11.** Asiatic Society, 74, Grosvenor Street, S.W. 4.30 p.m. Mr. Eldon Rutter, "The Arabians."
Empire Society, at Hotel Victoria, Northumberland Avenue, W.C. 8.30 p.m. Right Hon. Sir George Foster, "The New Internationalism."
Quekett Microscopical Club, 11, Chandos Street, Cavendish Square, W. 7.30 p.m. Mr. C. H. Oakden, "Various Studies of Photo-Micrographical Apparatus."
Roman Studies Society for the Promotion of, Burlington House, W. 4.30 p.m. Annual General Meeting. Paper by Dr. Martin Nilsson.
University of London, at King's College, Strand, W.C. 5.30 p.m. Sir Bernard Pares, "Contemporary Russia." (Lecture VII.)
At University College, Gower Street, W.C. 5.30 p.m. Mr. Robin Flower, "Life, History and Folklore of a Kerry Island." (Lecture IV.)
- WEDNESDAY, JUNE 12.** Eugenics Society, at Burlington House, W. 8 p.m. Discussion on "Would the general diffusion of a high degree of intelligence be desirable." Speakers: Mr. W. T. J. Gun and Dr. Benzie Dunkop.
Geological Society, Burlington House, W. 5.30 p.m. Dr. E. Mackenzie Taylor, "Base Exchange, and its Bearing on the Formation of Coal and Petroleum."
Research Defence Society, at 11, Chandos Street, Cavendish Square, W. 3 p.m. Prof. Dr. A. V. Hill, "Enemies of Knowledge." (Stephen Paget Memorial Lecture.)
University of London, at King's College, Strand, W.C. 5.30 p.m. Dr. H. Wildon Carr, "The Philosophy of Leibniz." (Lecture III.)
- THURSDAY, JUNE 13.** Historical Society, 22, Russell Square, W.C. 5 p.m. Alexander Prize Essay.
Optical Society, at the Imperial College of Science and Technology, Imperial Institute Road, S.W. 7.30 p.m. University of London, at King's College, Strand, W.C. 5.30 p.m. Mr. A. F. Mevendorf, "The Class-Struggle Idea in Current Soviet Legislation and Administration." (Lecture II.)
- FRIDAY, JUNE 14.** Malacological Society, at University College, Gower Street, W.C. 6 p.m.
Physical Society, at the Imperial College of Science and Technology, South Kensington, S.W. 5 p.m. 1. Mr. W. E. Pretty, "Pressure shifts in Line Spectra of Gases." 2. Messrs. A. S. M. Symons and J. Daley, "The Zeeman Effect for the Arc Spectrum of Gold." 3. Dr. W. Jevons, "The Band Spectrum of Lanthanum Monoxide."
University of London, at King's College, Strand, W.C. 5.30 p.m. Dr. H. Wildon Carr, "The Philosophy of Leibniz." (Lecture IV.)
At the London School of Economics, Houghton Street, W.C. 5 p.m. Mr. Philip Noel Baker, "The Consequences of the Paris Pact for the Renunciation of War." (Lecture II.)
At University College, Gower Street, W.C. 5 p.m. Mr. Hector Corfiato, "French Gothic and Early Renaissance."

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 3995.

VOL. LXXVII.

FRIDAY, JUNE 14th, 1929.

*All communications for the Society should be addressed to the Secretary, John Street,
Adelphi, W.C.(2.)*

NOTICES.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One-hundred-and-seventy-fifth Annual General Meeting, for the purpose of receiving the Council's Report and the Financial Statement for 1928, and for the election of Officers, will be held, in accordance with the Bye-laws, on Wednesday, June 26th, at 4 p.m.
(By Order of the Council),

GEORGE KENNETH MENZIES,
Secretary.

SIXTH ANNUAL COMPETITION OF INDUSTRIAL DESIGNS.

The entries for this year's Competition have now been received and although, until they have all been received and classified, it is not possible to state the exact number of designs entered, it is quite evident the interest in the Competition is well maintained and that there will be a further increase this year in the number of competitors and designs. Last year there were 1,024 competitors and 3,126 designs. So far as can be ascertained at present the numbers this year will be 1,231 competitors and about 3,500 designs. There is a large number of entries for Textile designs which show an increase of about 300 on last year's figure of 959. As the number of Textile designs entered in 1927 was 487 the increase in the last two years is noteworthy. In the Advertising Section there is an increase of over 300 designs, so that this year's entries for Posters, Show-cards, etc., are 600 in excess of those of 1927. There is an innovation this year in the Pottery and Glass Section as 140 actual specimens of fired pottery have been entered. The numbers of entries for the various other Sections of the Competition are about the same as in previous years.

The judging of the designs and awarding of the various Scholarships and Prizes will take place in July, and the accepted designs will be on view at the Imperial Institute, South Kensington, S.W., from August 3rd to September 1st, Sundays included.

It is interesting to note that offers of Prizes for designs in connection with the Competition for 1930 have already been received from a number of important manufacturers.

PROCEEDINGS OF THE SOCIETY.

TWENTIETH ORDINARY MEETING.

WEDNESDAY, MAY 1ST, 1929.

THE RIGHT HON. LORD ASKWITH, K.C.B., K.C., D.C.L., in the Chair.

THE CHAIRMAN, in introducing the lecturer, said Mr. Morley Horder was a Vice-President of the Society, and a very distinguished architect who had taken part in much antiquarian and artistic work connected with architecture in this country. He had, moreover, been the architect of many great works but took an interest both in big buildings and in small ones. He was very keen about ancient cottages, a subject in which the Society was interesting itself so much at the present time. Mr. Morley Horder would describe the procedure which he thought very important when new houses or other buildings were going to be built, and which was rarely followed at the present time. Children loved to make models which they could pull to pieces. They liked building sand castles, even though those castles were destroyed by the incoming waves. That kind of thing was innate in human beings and possibly in some animals also. It would be of interest to hear how far back any system of making models not after but before a building was commenced was used, and whether before making the marvellous things which had been excavated at Ur of the Chaldees and elsewhere the kings with unpronounceable names had an idea of what was going to be built put before them in a model by the architects of those days.

The following paper was then read :—

BUILDING MODELS.

By P. MORLEY HORDER, F.S.A.

The announcement in the *Royal Society of Arts Journal* that I should speak on the subject of Building Models produced a very considerable amount of correspondence and printed matter from various individuals and firms who apparently make it their entire business to model buildings and estates for the use of architects and surveyors. I had not the least idea that there were so many firms engaged in this work. Their literature set forth the quite obvious fact that models are always much more readily understood than architects'

plans or a surveyor's plotting of an estate. The professional modeller is certainly right in saying that a model is always much more readily understood than a plan by a client, but it is even more important for the architect to look at his design in the solid and in relation to the adjoining buildings or the contours of his site. Architectural draughtsmanship applied to the concrete art of building is as often as not a delusion and a snare to the architect, and certainly to the client. The skilful illustrator can slur parts in an architectural scheme which often a rough model will ruthlessly expose, and the building may be made to appear very attractive by the addition of individual illustrator's tricks of shading and backgrounds and foregrounds that do not exist. The art of architectural representation has become almost a profession in itself, and the walls of the Architectural Room at the Academy are lined with architectural designs expressed by clever illustrators. They do, of course, represent very fine architecture in an interesting way, but the majority of the drawings are pictorial rather than representative of the actuality which presumably will materialise. It would be interesting to collect, and to have an exhibition of the drawings that exist of any buildings in England before the nineteenth century. The records of the architectural drawings of the Great Masters of Architecture make no attempt at representation as we understand it to-day, and I question, if such drawings were presented to a modern client, whether he would consider them for a moment. He certainly would not understand their architectural values and would need to have them "rendered," as they say, by a modern illustrator such as I have described. The drawings one associates with buildings which have become architectural exemplars were simply a scholarly and proportionate expression of the plan. Architectural draughtsmanship, as we understand it in these days, apparently did not exist before the eighteenth century, and it would almost seem as if all the really great buildings of the world were built on the spot without any detailed plans and from mere sketches. Mr. Martin Briggs has dealt very ably with the subject of Architectural Models from the historical point of view in *The Burlington Magazine*. He suggests that the history of the architectural model in England cannot be traced with any certainty beyond the seventeenth century, and although, as I have said, he is dealing with the matter only from a historical point of view, it is interesting that he quotes as the first definite reference to models a passage from Sir Henry Wotton's "Elements of Architecture," published in 1664. This quotation is a perfect text for anything I have to say on the right use of models.

"Let no man that intendeth to build, settle his Fancie upon a draught of the Worke in paper, how exactly soever measured, or neatly set off in perspective; And much less upon a bare plante thereof, as they call the Schiographia or Ground lines; without a Modell of Type of the whole structure, and of every Parcell and Partition in Pasteboard or Wood. Next that the said Modell bee as plaine as may bee, without colours or other beautifying, lest the pleasure of the Eye preoccupate the Judgement; which advise omitted by the Italian

Architects, I find in Philippe de l'Orme, and therefore, though France be not the Theatre of best Buildings, it did merit some mention of his name.

"Lastly, the bigger that this Type be, it is still the better, not that I will perswade a man to such an enormity as that Modell, made by Antonio Labaco, of Saint Peter's Church in Rome, containing 22 foot in length, 16 in breadth, and 13 in heighth, and costing 4184 crowns; the price in truth of a reasonable Chapell; yet in a Fabrique of some 40 or 50 thousand pounds charge, I wish 30 pounds at least layd out before hand in an exact Modell; for a little misery in the Premises may easily breed some absurdity of greater charge in the Conclusion."

Sir Christopher Wren used models for such buildings as Pembroke College, Trinity College and St. Paul's. We read in *The Parentalia*: "Some Persons of Distinction, skill'd in Antiquity and Architecture, express'd themselves much pleased with the Design, and wished to see it in a Model; the Surveyor comply'd with their Desires as well as their own, and made a very curious large model in wood, accurately arought, and carv'd with all its proper Ornaments." Sir John Soane used models, far more than any other Architect, and left a large and very interesting collection in the Soane Museum. These models of Soane's come nearer to my idea of the purposes of a model. They are perhaps over-elaborate and unnecessarily expensive, but you do feel that they were made as much for his own assurance as to the design as for the benefit of his clients.

A few years ago Lady Constance Hatch made a very interesting collection of architectural models, and read a paper thereon in the Manchester City Art Gallery. One of the most interesting models shown was "the one made by Wren's contemporary, Mr. March, for William Cavendish, first Duke of Newcastle, who decided in his eighty-third year to build a house for himself on the site of Nottingham Castle. To his Grace plans were 'just a tissue of meticulous and inconsequent lines, conveying neither sense nor shape.' As we all know, this eccentric nobleman was merely voicing the impressions of many of our own clients unaccustomed to working drawings and those of the untrained public as a whole." Judging by the list of models which Lady Hatch compiled for her address, and which she very kindly lent me, she must have taken enormous pains to locate all the known examples of building models. A great number of the models recorded in Lady Hatch's very exhaustive list are, of course, merely recording models made immediately after the erection of the buildings, or much later, as interesting representations of well-known architecture, but I was surprised to see quite a number made for the purposes of showing the patron what sort of building was to be expected. In the course of my experience I have come across, in old houses of about the late eighteenth century, quite excellent models, showing with scholarly knowledge the details and proportions of the additions, generally to a much earlier period house. I have in my possession one such model of the garden front of a house in Dorsetshire which was found in the attic of the house some years ago. I suggest

advisedly that Lady Hatch's researches should be turned to some really useful account, and an attempt be made to collect all the contemporary models that can be found, and that the Architecture Club should have an exhibition of these, together with examples of models from which modern buildings have been built. I am sure that such an exhibition would be of the greatest interest to the public, and encourage them to be more observant and to see a building from all sides before they accept a representation which, as often as not, does not tell the whole truth at the outset. Such an exhibition would be encouraged, I am sure, by all the Schools of Art and would be of the greatest interest to their students. This exhibition might be varied by shewing stereoscopic representations on the screen of interesting buildings. In a way, the pictorial drawings and the model might well be compared with the flat picture and the stereoscopic picture on the screen. It is only in recent years that a vastly greater number of people have had to face the problem of building for themselves, and therefore there is a much larger public of necessity interested in building. For one person who finds any interest in walking round the Architectural Room of the Academy, a thousand will take an excited interest in a real house exhibited at the Ideal Homes or other Exhibition. There are comparatively few people who have sufficient technical knowledge to follow an architectural plan and elevation and judge their proportionate values, and therefore, to interest the public in a room hung with architectural drawings, the majority of them must be really more suitable for the black and white or Water Colour Room of the Academy. There is, of course a considerable public who are interested in topographical water colours for their charm of draughtsmanship or associate interest. But even these find an exhibition of purely architectural designs very trying in their effect, and they are really only interested in such drawings as are effective from the pictorial point of view rather than for their architectural values. Architectural forms and details in the round are at once arresting. Sculpture has very little meaning apart from architectural setting if it is agreed that it is really only a complementary art to architecture—the sculptors who recognise this must be severely handicapped unless they have had a considerable architectural training. If, instead of making their sculpture from drawings, they were given models to work from, their tasks would be very much simpler, and they would find that a great deal of unnecessary detail could be omitted. This reminds one of one of the greatest values of models in the elimination of every unnecessary detail that does not contribute to the chief aim of architectural form, namely, proportion. This really is an answer to the criticism that modelling is expensive. As a matter of real fact, the results in the hands of educated minds must make for the greatest economy in the use of materials. The practice of using models in the right way in an architect's office will very soon demonstrate how absolutely true this is, and it will be found astonishing how much in the way of expensive detail which seemed necessary in the flat drawing can be eliminated

when the form of the building has been reduced to its simplest outlines. Modelling, to be really useful in an architect's office, should start after the sketch ideas are produced, and should continue until the completed design becomes the builder's working drawing. In fact, the usefulness of models in an architect's office depends on having a draughtsman skilful enough to set up quickly in some form of paper board the elevations of any plans for consideration and criticism. The material used should be of such a nature that it can be easily altered until the form seems as direct and expressive as it can be in relation to the building materials proposed. In my experience I have found clients welcome this method of enabling them really to visualise and become familiar with the form of the building they have commissioned, and generally ask for the model to be carried even more into detail than is necessary. They certainly take a much more intelligent interest in the design than in any drawing, and see at once the arguments for not doing things which are unsuitable by realising the consequences so clearly made manifest in the concrete form exhibited in the model. It obviously does take longer to make a model than to set up elevations on paper; on the other hand, how often does the conscientious architect look at his complete working drawings, which have probably taken weeks to make, and suddenly realise that they have not worked out as he anticipated. The rough model might have brought him to this conclusion before so much labour had been expended. The rough preliminary model is particularly valuable in connection with the contours of a difficult site. Useful variations often suggest themselves in the design of a house if the garden is approximated to in the model. Indeed, every site seems to have its particular conditions and relationship to aspect, views and approach, all of which can be visualised much more clearly in elevations projected in solid form. Architects of great imagination and power may say we can visualise all this in perspective sketches and all this modelling is quite unnecessary labour. But even these talented men will find that their clients will thank them for expressing what they wish done in this way, and they are much more likely to convince them. Surely it is the rarest thing to see a modern building which is so convincing in its growth from its site and its charm of material that such aids as I am suggesting can be neglected by the majority of the profession. Apart from the question of whether modelling can be used with advantage for all the hundred and one problems which present themselves in an architect's office, there can be no question in my mind that the task of an assessor in great competitions would be simplified, and the results would be vastly more satisfactory if, instead of decisions being taken on working elevations or elaborate perspectives, the final decision of the assessors should be confirmed by models, complete enough to show the relation of any building in a town to its site and adjacent buildings. The housing and tabulating of drawings of executed buildings is a serious problem in an architect's office. He is continually wishing to have a bonfire, as no architect,

I am sure, ever wishes to refer to his past misdeeds. But unfortunately they have to be kept for possible reference, and if he begins to burn records of any one job, he nearly always finds that it is just those the client asks him to refer to. The difficulty of housing models is of course a much greater one. But if they are made in the way I suggest there is really no need to keep them, as all the points which have been made in a model are finally registered in the working drawings. A few of the more important and finished models are naturally preserved, but the majority either fall to pieces or are destroyed for the reasons which I have given. The rather miscellaneous collection of slides illustrating models which I show to-night are not therefore in any way suggestive of any particular architectural methods, but rather to shew the varying purposes for which models can be usefully made. If anything I have had to say about the method of architectural representation will further the beauty in building, I shall be grateful. The surpassing beauty of England is in danger from every form of ill-considered design and the use of unsuitable material. Housing, we are told, is still a pressing problem, and large areas of land are still to be covered with groups of standardised houses. The real difficulty is the grouping and patterning of the units to the contours of the site. To assemble all the units on the roads in model form, and decide the points of emphasis to save such large schemes from monotony on the one hand and from really meretricious variety on the other, can only be done satisfactorily in my opinion by way of a small scale model, more especially where the ground is undulating. The old village was not produced by any methods such as we associate with an architect's office. It was an uncontrolled growth of craftsmanship interpreted with natural local materials. The conditions which produced this beauty have gone, and for this reason I enter a plea for their preservation. Mass production has taken the place of the old methods, and economic necessities require haste and the use of less sympathetic materials. But forms can still be controlled and standardised into beauty, but only by the most careful consideration of the massing and architectural connection of the units into less self-conscious and assertive forms than are littering the countryside to-day.

DISCUSSION.

Mr. Morley Horder, in reply to a member of the audience, who asked how the models were made, and what materials were as a rule employed, said that as the models must be so made that they could be easily pulled about and altered structurally, he always used some form of paper board.

THE CHAIRMAN said Mr. Morley Horder had given a very interesting lecture. The Secretary of the Society had been kind enough to give him a reference to the review of a book by Major R. W. G. Hingston on "Problems of Instinct and Intelligence," with reference to the remarks he made in opening the meeting about

even lower animals than man going in for model making. It was very possible that valuable lessons might be learned from the study of the behaviour of animals and insects in that connection. Major R. W. G. Hingston, in his work, *Problems of Instinct and Intelligence*, had told of a case where a wasp had deliberately planned out the whole of her nest before she built it: "One morning, in a deserted house, I happened to see on a whitewashed wall an example of this mason's work. The wasp had completed two of her cells and was about to commence the third. But here is the point which literally amazed me. In addition to the two completed chambers, the wasp had mapped out the scheme of architecture for all the subsequent cells of her nest. Before me on the wall was a definite plan, a mapping out of the final structure, made, I have no doubt, for the same purpose that the human architect maps out a house. . . . At the very commencement of her labour she had pre-arranged for the whole work. This, I am confident, implies intelligence."

Mr. Horder had shown how within the last few centuries a model had very occasionally been made before a building was put up, and had been of service. Personally, he thought that a great many portions of this country might have been differently covered with Government houses if a plan had been made of the countryside with the type of houses and a sketch of the contour laid out beforehand to facilitate criticism. That was done in connection with a very important structure in London. When Sir Edward Lutyens designed the Cenotaph in Whitehall, he first erected a full-sized model before the actual building was made, so that the public could see what it would look like. The public appreciated it and the result was the Cenotaph.

The lecturer alluded at the end of his remarks to the important point of the future housing of this country, and spoke about the slums. All three political parties were talking about what they were going to do with the slums and what they were going to do about more housing. The amount of money which would have to be spent, and the difficult problem of ejecting people who did not want to leave and transferring them to another site, and of pulling down houses and re-erecting more, would be facilitated if some models were made beforehand to enable the ordinary man to understand better what the idea was with reference to surrounding buildings, streets, railways and everything else than was possible by mere plans upon paper. He fancied that models could be produced with little expense and with vast advantage, and he was glad Mr. Morley Horder had made a protest as to the importance of showing models and of letting people judge before an irrevocable decision was taken. Large sums of money were spent at the present time in putting up buildings which later on everyone might desire to pull down but which would be too expensive to scrap.

In modern Berlin there was a very big building with an enormous cross at the top of it. It was said that cross was added because the plan on the paper was sent to the Kaiser, who put a mark against it, and the architect, who did not dare to question what the Kaiser meant by it, took it to mean a cross, and put an enormous cross on the top of the building. Now everyone would like that cross taken down; probably the Kaiser himself, who at any rate pretended to be artistic, if he had seen a model with that heavy cross on the top of the building, would have said that he did not mean that or that, at any rate, it should be made smaller and not correspond with the way in which his pencil had wandered over the paper.

Mr. John B. THORP said he had made a study of model-making the whole of his life, and only wished that architects would properly appreciate the value of models. A short time ago he made a model, for a well known architect at Birmingham, of a high tower which had a finial at the top. On paper that finial looked quite in proportion,

but when the architect looked at the model he saw that in the real building the finial would appear too small when it was looked at from the natural eye level, and he made the finial half as big again. It looked out of proportion on paper, but in the real thing it looked exactly in proportion. That could never have been done had the tower been actually erected with the smaller finial.

The lecturer had said that models were made in the 16th and 17th centuries and personally he understood that in the 17th century models were used a great deal more than plans. Many people were familiar with the very fine model of Wren's first design for St. Paul's which was at present kept in an out-of-the-way place in that cathedral and which many people were therefore unable to see. It was some fifteen to twenty feet long and made of wood. It would be of advantage if the Society would use its influence to have that model removed and put in the London Museum where it could be seen by the general public.

An architect as well as a layman could appreciate a model where he could not appreciate a flat drawing. Some time ago he made a model for an architect of a very complicated roof and told the architect that it would not work. The architect did not believe him until he came and saw the model for himself and it was only in that way that the mistake was discovered.

Mr. Morley Horder said that he hoped that the Architects' Club would urge the Chapter of St. Paul's to allow them to exhibit the model referred to by Mr. Thorp.

On the motion of the Chairman a vote of thanks to the lecturer was carried unanimously and the proceedings then terminated.

OBITUARY

H. H. SIR BHAWANT SINGH BAHADUR K. C. S. I. MAHARAJ RANA OF JHALAWAR. The Maharaj Rana of Jhalawar who died suddenly while on his way to Europe in April last was born on September 4th 1874 and was the son of Thakur Chatrasalji of Fatehpur. He was educated at the Mayo College Ajmer and at the age of 25 was selected by the British Government to occupy the throne of Jhalawar which had become vacant owing to the deposition for maladministration of the former ruler Jalim Singh. The severe famine of 1899 the year following his elevation to the throne gave the new ruler an opportunity to show his mettle in the supervision of relief measures and the personal interest thus shown in the welfare and good government of his people was continuously maintained throughout his life.

The Maharaj Rana's interests were largely in the direction of science, art and literature and these interests were stimulated by a succession of visits to Europe which afforded him opportunities of forming personal relationships with a number of persons of scientific or literary eminence in this country. He was responsible for many reforms in the State of Jhalawar including the establishment of a two chamber Legislature and the grant of municipal self government. He also furthered the cause of education and enlightenment by the foundation of many new schools for boys and girls, the Rajendra Literary Institute, the Shakespeare Society of Jhalawar and other similar institutions. His Highness had been a Fellow of the Royal Society of Arts since 1912 and was a member of a large number of literary and scientific Societies in this country where his attractive personality gave him a wide circle of friends both in the social and intellectual world. He is succeeded by his only son, Kumar Rajendra Singh.

NOTES ON BOOKS.

IMMIGRANT BACKGROUNDS Henry Pratt Fairchild, Editor, by Fifteen Contributors New York John Wiley and Sons, Inc London Chapman and Hall, Limited 13s 6d net

First glances, by a casual turning over of the pages show a notable conciseness combined with clearness of expression, so that the early impression is distinctly favourable. In our time a preface to a new book is an almost universal feature, and in addition there is often a dedication and an adulatory introduction by a more or less well known person hence our after-glance at the place where the preface usually is was quite in order but we found no formal preface not even as much as Abernethy's notably concise three word preface "Read my Book". Abernethy's volume on surgical experiences was received with acclamation and in a quite friendly spirit it was usually termed "My Book" in honour of the concise preface and of Abernethy's incisive lucid style. The ingenious author of the political skit, "All the Talents" which was published in the pre-Victorian era that gave us the writings of Abernethy satirised prefatory adulations and superfluities by a long and grovelling dedication to the Emperor of China. There is however a covert admission that the writer had no knowledge of his Majesty but realised the importance of a high title at the front of a book.

In the first essay "What is an Immigrant Background?" pp 1 to 13 Professor Fairchild who occupies the chair of Sociology in New York University tells us what we are to understand by the term. He says (p 1) that the new political orientation is scarcely more than an incident. It is the environment in its entirety which he has left behind that constitutes the background.

Before briefly touching on the principal points of Professor Fairchild's new and important contribution to Sociology we may revert to our own discursive commencement and indicate the notably useful lesson in book construction which he gives to the literary world. He shows that preface and introduction may well be set aside in many cases the first sentences of the book itself indicating its nature and aims.

In the 260 pages which constitute the book under notice we find important new strains of thought for the economist the statesman and the general reader the essayists who co-operate with Professor Fairchild working in that general spirit of unity which makes reading easy and profitable.

Our endeavour to convey some partial notion of the varied store of facts and opinions as to fundamentals in comparative sociology must consist of a few exemplary extracts with remarks.

On p 268 under the general heading "Other Peoples" and sub heading "The Turks" we read "Until the revolution of the young Turks in 1908 Turkey had been an absolute monarchy. In 1922 the nationalist government abolished the Sultanate. Thus the great historical event of 1453 which drove learning westward has its incidence changed by the Great War."

Let us now turn to pp 240 and 241 the conclusion of an essay in which the Editor of *The Forum* (H G Leach) studied the background of the Swedes. He seems to dread the thought of such material as may be expected in the compatriots or descendants of such men as Gustavus Adolphus Scheek and Buselius sinking in a welter of slang jazz chewing gum mileage tablets and the movies also he makes suggestions for the utilisation of such material. Perhaps we can summarise all that is to be said in the words, "Read Fairchild's Book."

EVERYDAY ART AT SCHOOL AND HOME. By D. D. Sawyer. London. B T. Batsford, Ltd. 12s. 6d net.

It would be rash of the highbrow critic to "turn up his nose" at this book, with its little texts and sentimental poems. It would be rash, because it needs a special talent for a grown-up to retrace his (or her) steps so as to enable him (or her) to guide the young through their early stages of artistic expression. Miss Sawyer has this special talent. Some books of this class are bad specimens of a good type, "Everyday Art" is almost the opposite, namely a good specimen of a dangerous, if not necessarily bad type. In short, Miss Sawyer has a second talent that of expressing herself in words and pictures, and so communicating her personality to her readers. Thus she disarms the critic, who would often challenge the letter of her law if its spirit were not entirely sympathetic.

Indeed, the present reviewer has never known a generous spirit bubble over into print with such happy effect. There is of course no attempt made here to turn children into little Michel-Angelos. But one cannot help hoping, and almost believing that with the aid of this book parents and teachers will turn them into more sensitive and civilised people than their likes of the previous generation.

An excellent chapter deals with lettering a subject that I would not have dreamed of in the wildest dreams of my own childhood as actually an art. It was clearly an engine of penance. Three chapters together are called 'Drawing exercises to develop interest in home life'. A very good motive for children take home life too much for granted, or think of it only as a beginning and not also as an end.

So in spite of Miss Sawyer's Neo-platonic-evangelical-pantheism one must recommend her book very highly indeed.

P B

EXHIBITION OF APPLIED ART.

EXHIBITION OF ARTS AND CRAFTS L C C CENTRAL SCHOOL OF ARTS AND CRAFTS SOUTHAMPTON ROW. The problem of culture in its widest aspect is that of giving all human beings a footing at least on a high common plain of sensibility. It should not be too much to ask that in the modern world all the inhabitants of a progressive country should speak the same language. That they should do so is just and expedient and an upshot to be hastened by all the reasonable intellectual and economic influences at the disposal of society.

Arts and crafts may be regarded as both a sign and an expression as both discipline and emancipation. Talent can be fostered and good taste can to an important extent, be inculcated even where there is little talent. The latter function the inculcation of good taste is being performed with increasing effectiveness by the technical institutes of London. These metropolitan centres of technique and culture are being more and more appreciated by thousands of people and the present exhibition does great credit, not only to the students but also to their instructors.

There is a wide range of exhibits. The pottery is interesting. M K Vowles, as usual, shows an artist's feeling for colour and is run close by S Peereboom with a desirable jug. A Goodborn with rather more abstract patterns, is good so is J Grant. W Turner and L Cooke are so able that one hopes they will turn from *genre* in porcelain and apply their talents to more sympathetic ends.

The metal work shows nothing if not a very honest striving to compromise between utility, originality and sound traditions of design. Note the work of C W Gilbert and A Nimmo, the small engraved silver salver by A L Wyatt, and the tea-pot by M Fells.

Turning to book production, we find that the little printing on view is good,

and that there is quite a wealth of admirable binding. Some of these names are already known, but not as widely as they ought to be. Miss E. Greenhill's work is excellent, or when not excellent, enterprising. Her cover for a volume of Blake is creative but not altogether right. P. A. Polak and C. Cresswell are fine craftsmen; B. Bewsher is an admirable scribe.

Among exhibitors of patterns for textiles, Goetzer Steyn is conspicuous—evidently, by the way, a many-sided person. M. Yonge seems not inferior; there is to-day a goodly company of clever workers in this department.

It is another story when we leave the crafts and come to the fine arts, but one hardly expects to find more than evidences of pains taken in the pictures and statues shown by students in any school whatsoever. The exhibition closes on June 26th.

P. B.

GENERAL NOTE.

RIBA SCHOLARSHIPS IN ARCHITECTURE. The Royal Institute of British Architects offer for award in July, 1929, two Maintenance Scholarships in Architecture of a maximum value of £100 per annum, tenable from October, 1929.

The Scholarships will be tenable, in the first instance for one year, and will be renewable for two further periods of one year each. They are intended to enable students who have not the necessary means to attend an approved course at one of the Schools of Architecture recognised for exemption from the RIBA Examinations. Students who are already taking such a course are not eligible to apply for a Scholarship.

Particulars and forms of application may be obtained from the Secretary to the Board of Architectural Education, RIBA, 9, Conduit Street, London, W. 1.

The closing date for the receipt of completed applications is the 1st July 1929.

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

MONDAY, JUNE 17. University of London, at King's College, Strand, W.C. 5.30 p.m. Dr H. Wildon Carr, "The Philosophy of Leibniz" (Lecture I).
At University College, Gower Street, W.C. 4.30 p.m. Prof. Martin P. Nilsson, "Homer and Mycenaean" (Lecture I).

TUESDAY, JUNE 18. Imperial Institute (Cinema), South Kensington, S.W. 2.15 p.m. Mr Clifford Collins, "Trading with South Sea Cannibals".
Statistical Society, at the Royal Society of Arts, Adelphi, W.C. 5.15 p.m. Sir Hubert Llewellyn Smith, "The New Survey of London Life and Labour".
University of London, at King's College, Strand, W.C. 5.30 p.m. Sir Bernard Parey, "Contemporary Russia" (Lecture VIII).

WEDNESDAY, JUNE 19. British Academy, Burlington Gardens, W. 5 p.m. Dr Camillo Pellizzi, "Romanticism and Regionalism".
Imperial Institute (Cinema), South Kensington, S.W. 2.15 p.m. Mr A. E. Smith, "London—the Imperial Port".

Metacological Society, 28, Cromwell Road, S.W. 5 p.m. 1. Dr F. J. W. Whipple, "Potential Gradient and Atmospheric Pressure: the Influence of 'Summer Time'"; 2. Mr. J. Bamford, "Vertical Air-currents as Measured by Pilot Balloons"; 3. Dr George Smith, "Studies on the Rhone Glacier, 1927. The Relationship between the Average Air-temperature and the Rate of Melting of the Surface of the Glacier".

University of London, at King's College, Strand, W.C. 5.30 p.m. Dr H. Wildon Carr, "The Philosophy of Leibniz" (Lecture VI).
At University College, Gower Street, W.C. 4.30 p.m. Prof. Martin P. Nilsson, "Homer and Mycenaean" (Lecture II).

THURSDAY, JUNE 20. Chemical Society, Burlington House, W. 8 p.m. 1. Mr H. B. Baker, "Manipulation in Intensive Drying"; 2. Mr W. A. Bone, "Notes on Intensive Drying of Gaseous Media"; 3. Mr H. J. Emsley, "The Light emission from the Phosphorescent Flames of Ether, Acetaldehyde, Propionaldehyde and N-Hexane"; 4. Messrs A. J. H. House, J. Kenyon and H. Phillips, "The Relative Configuration of d- β -Octanol and its Dextrorotatory Halides. The Interconversion of the Optically Active β -Octanols by a New Method".

Constructive Birth Control and Racial Progress, Society for, at the Essex Hall, Essex Street, Strand, W.C. 8 p.m. Mrs Com B. Hodson, "Birth Control Clinics in the United States".

FRIDAY, JUNE 21. Imperial Institute (Cinema), South Kensington, S.W. 2.15 p.m. Colonel J. A. Haddick, "India, Past and Present".
University of London, at King's College, Strand, W.C. 5.30 p.m. H. E. Monsieus, "Sources of the History of the Greek War of Independence".
At the London School of Economics, Houghton Street, W.C. 5 p.m. Mr Philip Noel Baker, "The Consequences of the Paris Pact for the Renunciation of War" (Lecture III).
At University College, Gower Street, W.C. 5.30 p.m. Prof. Martin P. Nilsson, "Homer and Mycenaean" (Lecture III).
5 p.m. Prof. A. E. Richardson, "French Late Renaissance Architecture".

JOURNAL OF THE ROYAL SOCIETY OF ARTS.

No. 3,996.

VOL. LXXVII.

FRIDAY, JUNE 21st, 1929.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C. 2

FINANCIAL STATEMENT FOR 1928.

The following statement is published in this week's *Journal* in accordance with Sec. 25 of the Society's Bye-laws. -

INCOME AND EXPENDITURE ACCOUNT.

January 1st to December 31st, 1928.

Dr.	£	s.	d.	£	s.	d.	Cr.	£	s.	d.	£	s.	d.
To <i>Journal</i> , including Printing Publishing and Adverti- sements	3,566	3	1				By Subscriptions	6,084	10	0			
„ Library and Bookbinding	80	0	0				„ Life Compositions	568	10	0			
„ Medals:— Albert	21	10	6				„ Interest and Dividends on Society's Investments ..	373	6	10			
Society's ..	24	10	0				„ Ground Rents	365	9	0			
	46	0	6				„ Interest, Dividends, and Ground Rents from Trust Funds for General Pur- poses	496	4	8			
„ Cantor Lectures	131	7	4				Do. from Building and En- dowment Funds	22	7	5			
„ Expenses of Examinations				3,813	10	11	„ Sales, etc.:— <i>Journal</i>	195	0	1			
„ House:— Rates and Taxes ..	375	2	10				Do. Advertisements ..	750	0	0			
Insurance, Gas, Coal, Expenses and Charges Incidental to Meetings	706	10	5				Cantor Lectures	38	10	8			
Repairs	230	17	2								988	10	9
Installation of Cinema- tograph	106	12	7				„ Examination Fees and Advertisements in and Sale of Examination Papers ..	15,468	8	0			
				1,419	3	0	„ Charges for Expenses for the use of Meeting Room	362	0	0			
„ Office Expenses:— Salaries, Wages, and Pensions	4,406	8	7				„ Rent of Cellars	75	0	0			
Stationery and Office Printing	560	5	0				„ Balance, being Excess of Expenditure over Income transferred to Capital Account (see Balance Sheet)	463	7	0			
Postages, Parcels, and Messengers' Fares ..	281	1	0										
				5,247	14	7							
„ Committees:— General Expenses				35	15	6							
„ Industrial Art Competition				516	2	5							
„ Interest on Bank Overdraft				92	11	11							
„ Superannuation Fund				524	8	0							
				<u>£25,248</u>	<u>5</u>	<u>8</u>					<u>£25,248</u>	<u>5</u>	<u>8</u>

TRUST INCOME AND EXPENDITURE ACCOUNTS.

Dr.			Cr.	Trust Accumulations, Dec. 31st, 1928.	
	£	s. d.		£	s. d.
TO ART CONGRESSES STUDENTSHIP—			JOHN STOCK TRUST—		
Interest on Investments	24	14 9	By Balance, January 1st, 1928 ..	49	17 8
Prize and expenses	61	16 6	„ Interest on Investments	3	10 2
Balance due to the Society		37 1 9			53 7 5
Balance forward	1,146	13 5	NORTH LONDON EXHIBITION TRUST—		
			„ Balance, January 1st, 1928 ..	70	15 0
			„ Interest on Investments	6	14 10
			Less Prizes for Industrial	77	9 10
			Design	48	4 0
					34 5 10
			DR. ALDRED'S TRUST—		
			„ Balance, January 1st, 1928 ..	73	1 8
			„ Interest on Investments	7	14 5
					80 16 1
			THOMAS HOWARD'S TRUST—		
			„ Balance, January 1st, 1928 ..	77	17 8
			„ Interest on Investments	19	19 8
					97 17 4
			MULLEADY TRUST—		
			„ Balance, January 1st, 1928 ..	35	15 5
			„ Interest on Investments	5	11 0
					41 6 5
			DR. SWINEY'S TRUST—		
			„ Balance, January 1st, 1928 ..	160	0 0
			„ Ground Rents (Income from)	180	0 0
			Less Cost of Cup	340	0 0
			Transfer to Society's	100	0 0
			Income and Expen-		
			diture a/c	140	0 0
					100 0 0
			FRANCIS COBB TRUST		
			Balance, January 1st, 1928 ..	54	0 1
			Interest on Investments	8	18 10
					62 18 11
			LE NEVE FOSTER PRIZE TRUST		
			Balance, January 1st, 1928 ..	24	5 4
			Interest on Investments	6	0 6
					30 5 10
			FOTHERGILL TRUST		
			Balance, January 1st, 1928 ..	30	13 11
			Interest on Investments	13	12 5
					44 6 4
			BENJAMIN SHAW TRUST—		
			Balance, January 1st, 1928 ..	27	10 8
			Interest on Investments	4	13 6
					32 4 2
			CANTOR TRUST—		
			Interest on Investments	137	2 0
			Ground Rents (Income from)	141	0 0
					278 2 0
			Less Transfer to Society's		
			Income & Expenditure a/c	278	2 0
					- - -
			DAVIS TRUST—		
			Interest on Investments	78	2 8
			Less Transfer to Society's		
			Income & Expenditure a/c	78	2 8
					- - -
			SIR GEORGE BIRDWOOD MEMORIAL TRUST—		
			Interest on Investments	36	15 0
			Less cost of Sir E. Galt's		
			Lecture (including Printing)	36	15 0
					- - -
			RUSSIAN EMBASSY PRIZE TRUST—		
			Balance, January 1st, 1928 ..	25	0 0
			Interest on Investments	5	0 0
					30 0 0
			DR. MANN TRUST—		
			Balance, January 1st, 1928 ..	85	10 1
			Interest on Investments	51	8 6
			Less Paid for Lectures	136	18 7
					80 8 4
Carried forward	£1,188	15 2	Carried forward		56 10 3

TRUST INCOME AND EXPENDITURE ACCOUNTS—continued.

	£	s.	d.
Brought forward	1,183	15	2
	£1,183	15	2

	£	s.	d.
Brought forward	663	18	7
By OWAN JONES MEMORIAL TRUST—			
Interest on Investments	15	13	4
Less Prizes awarded	15	13	4
THOMAS GRAY TRUST—			
Balance, January 1st, 1928 ..	383	2	1
Interest on Investments	272	1	2
	655	3	3
Less Paid for Prizes and Essay	135	6	8
			519 16 7
TRUEMAN WOOD LECTURE TRUST—			
Interest on Investments ...	32	10	10
Less cost of Dr. Jean's Lecture (including Printing) ..	32	10	10
	£1,183	15	2

1929—Jan. 1. By Balance brought forward £1,146 13 5

BALANCE SHEET, December 31st, 1928.

	£	s.	d.	£	s.	d.
Capital Account—						
As on January 1st, 1928 ..	75,728	11	7			
Donations re Building Fund	8	9	4			
	75,737	0	11			
Less Income and Expenditure Account Balance ..	463	7	0			
	75,273	13	11			
Sundry Creditors	822	4	0			
Bank Overdraft	6,504	8	11			
Industrial Art Fund (Donations received and not yet expended)	348	6	8			
Trust Funds—						
Capital Account	25,410	6	0			
Accumulations under Trust Income and Expenditure Account ..	1,146	18	5			
	26,556	19	5			
	£109,505	12	11			

	£	s.	d.	£	s.	d.
Freehold Premises 18 and 19 John Street, as on December 31st, 1923 ..	*50,392	16	7			
Books, Pictures, etc.	10,000	0	0			
Investments (see schedule) ..	17,481	8	5			
Subscriptions outstanding ..	2,144	11	0			
Sundry Debtors and Ground Rents outstanding	1,586	10	11			
Paid on Account of 1929 Examinations	2,400	0	0			
Trust Funds—						
Investments	25,410	6	0			
Ground Rents, etc.	90	0	0			
	25,500	6	0			
	£109,505	12	11			

PRESERVATION OF ANCIENT COTTAGES FUND.

	£	s.	d.
Donations etc. received to date	6,796	14	1
	6,796	14	1

	£	s.	d.	£	s.	d.
£3,341 18 3 4 ⁰ . Consolidated Stock	3,000	0	0			
Hampstead Garden Suburb Debenture Stock	55	0	0			
Amount paid to preserve Cottages at Worthing ..	60	0	0			
Expenses, printing, postage, etc.	389	4	4			
Cash at Bank	3,292	9	9			

6,796 14 1

We have audited the above Accounts and Balance Sheet for 1928 with the books, accounts and vouchers relating thereto, and certify them as being in accordance therewith. We have verified the Bank Balances and investments.

KNOX, CROPPER & CO.,

Chartered Accountants.

Spencer House, South Place, E.C. 2.
5th June, 1929.

* Towards this amount £42,508 13s. 2d. has been received in subscriptions from Fellows of the Society and others, and the excess of income over expenditure for the years 1922-28 amounted to £2,904 14s. 11d. There is therefore still a deficit of £3,981 8s. 6d. on the Building Fund, and the Council earnestly appeal to Fellows to assist them in clearing it off.

TRUST INCOME AND EXPENDITURE ACCOUNTS.

Dr.

Cr.

	£	s.	d.	£	s.	d.
To ART CONGRESS STUDENTSHIP -						
Interest on Investments	24	14	9			
Prize and expenses	61	16	6			
Balance due to the Society				37	1	9
Balance forward				1,146	13	5

	£	s.	d.	£	s.	d.
JOHN STOCK TRUST—						
By Balance, January 1st, 1928	49	17	8			
Interest on Investments	3	10	2			
				53	7	5
NORTH LONDON EXHIBITION TRUST—						
Balance, January 1st, 1928	70	15	0			
Interest on Investments	6	14	10			
Less Prizes for Industrial Design	77	9	10			
	43	4	0			
				34	5	10
DR. ALDRED'S TRUST—						
Balance, January 1st, 1928	73	1	8			
Interest on Investments	7	14	5			
				80	16	1
THOMAS HOWARD'S TRUST—						
Balance, January 1st, 1928	77	17	8			
Interest on Investments	10	10	8			
				97	17	4
MULEKADY TRUST—						
Balance, January 1st, 1928	35	15	5			
Interest on Investments	5	11	0			
				41	6	5
DR. SWINEY'S TRUST—						
Balance, January 1st, 1928	180	0	0			
Ground Rents (Income from)	180	0	0			
	340	0	0			
Less Cost of Cup	100	0	0			
Transfer to Society's Income and Expenditure a/c	110	0	0			
				100	0	0
FRANCIS COBB TRUST						
Balance, January 1st, 1928	54	0	1			
Interest on Investments	8	18	10			
				62	18	11
J. K. NEVE FOSTER PRIZE TRUST						
Balance, January 1st, 1928	24	5	4			
Interest on Investments	6	0	6			
				30	5	10
FOTHERGILL TRUST						
Balance, January 1st, 1928	30	13	11			
Interest on Investments	13	12	5			
				44	6	4
BENJAMIN SHAW TRUST						
Balance, January 1st, 1928	27	10	8			
Interest on Investments	4	13	6			
				32	4	2
CANTOR TRUST						
Interest on Investments	137	2	0			
Ground Rents (Income from)	141	0	0			
	278	2	0			
Less Transfer to Society's Income & Expenditure a/c	278	2	0			
				-	-	-
DAVIS TRUST						
Interest on Investments	78	2	8			
Less Transfer to Society's Income & Expenditure a/c	78	2	8			
				-	-	-
SIR GEORGE BIRDWOOD MEMORIAL TRUST						
Interest on Investments	36	15	0			
Less cost of Sir E. Galt's Lecture (including Printing)	36	15	0			
				-	-	-
RUSSIAN EMBASSY PRIZE TRUST						
Balance, January 1st, 1928	25	0	0			
Interest on Investments	5	0	0			
				30	0	0
DR. MANN TRUST						
Balance, January 1st, 1928	85	10	1			
Interest on Investments	51	8	6			
	136	18	7			
Less Paid for Lectures	80	8	4			
				56	10	3

Carried forward

£1,183 15 2

Carried forward

663 18 7

TRUST INCOME AND EXPENDITURE ACCOUNTS—*continued.*

	£	s.	d.
Brought forward	1,183	15	2
	£1,183	15	2

	£	s.	d.	£	s.	d.
Brought forward	663	18	7			
By OWEN JONES MEMORIAL TRUST—						
Interest on Investments	15	13	4			
Less Prizes awarded	15	13	4			
THOMAS GRAY TRUST—						
Balance, January 1st, 1928 ..	383	2	1			
Interest on Investments	272	1	2			
	655	3	3			
Less Paid for Prizes and Essay	135	6	8			
				519	16	7
TRUMAN WOOD LECTURE TRUST—						
Interest on Investments	32	10	10			
Less cost of Dr. Jean's Lecture (including Printing) ..	32	10	10			
				£1,183	15	2

1929—Jan. 1. By Balance brought forward £1,146 13 5

BALANCE SHEET, December 31st, 1928.

	£	s.	d.	£	s.	d.
Capital Account—						
As on January 1st, 1928	75,728	11	7			
Donations re Building Fund	8	9	4			
	75,737	0	11			
Less Income and Expenditure Account Balance ..	403	7	0			
				75,273	13	11
Sundry Creditors				822	4	0
Bank Overdraft				6,504	8	11
Industrial Art Fund (Donations received and not yet expended) ...				348	6	8
Trust Funds—						
Capital Account	25,410	6	0			
Accumulations under Trust Income and Expenditure Account	1,146	13	5			
				26,556	19	5
				£109,505	12	11

	£	s.	d.	£	s.	d.
Freehold Premises						
18 and 19 John Street, as on December 31st, 1928 ..				*50,392	16	7
Books, Pictures, etc.				10,000	0	0
Investments (see schedule)				17,481	8	5
Subscriptions outstanding				2,144	11	0
Sundry Debtors and Ground Rents outstanding ..				1,586	10	11
Paid on Account of 1929 Examinations				2,400	0	0
Trust Funds						
Investments	25,410	6	0			
Ground Rents, etc.	90	0	0			
				25,500	6	0
				£109,505	12	11

PRESERVATION OF ANCIENT COTTAGES FUND.

	£	s.	d.
Donations etc received to date	6,796	14	1
	6,796	14	1

	£	s.	d.	£	s.	d.
£3,541 18 3 4 ⁰ . Consolidated Stock	3,000	0	0			
Hampstead Garden Suburb Debenture Stock	55	0	0			
Amount paid to preserve Cottages at Worthing ..	60	0	0			
Expenses, printing, postage, etc.	389	4	4			
Cash at Bank	3,292	9	9			
				6,796	14	1

We have audited the above Accounts and Balance Sheet for 1928 with the books, accounts and vouchers relating thereto, and certify them as being in accordance therewith. We have verified the Bank Balances and investments.

KNOX, CROPPER & CO.,

Chartered Accountants.

Spencer House, South Place, E.C. 2.
5th June, 1929.

* Towards this amount £48,506 13s. 2d. has been received in subscriptions from Fellows of the Society and others, and the excess of income over expenditure for the years 1922-28 amounted to £2,904 14s. 11d. There is therefore still a deficit of £3,981 8s. 6d. on the Building Fund, and the Council earnestly appeal to Fellows to assist them in clearing it off.

SCHEDULE OF THE SOCIETY'S INVESTMENTS.

		Standing in the Books at a Value of	
Ground-rents (amount invested)		£10,496	2 9
£217 0 0	Great Indian Peninsula Railway 4 per cent. Guaranteed Debenture Stock	157	0 0
£500 0 0	New South Wales 4 per cent. Stock	445	0 0
£500 0 0	Canada 3½ per cent. Stock	430	0 0
£100 0 0	Queensland 4 per cent. Stock	97	0 0
£530 10 1	New South Wales 5 per cent. Stock	514	11 0
£500 0 0	Natal 4 per cent. Stock	445	0 0
£321 15 0	Metropolitan Water Board "B" Stock	209	3 0
£5 0 0	New River Company Shares	6	0 0
£3,408 14 6	India 3½ per cent. Stock	2,181	11 8
£500 0 0	South Australia 4 per cent. Stock	500	0 0
£2,000 0 0	War Loan 5 per cent.	2,000	0 0
		£17,481	8 5

The Market value of the above investments on December 31, 1928, was £17,752 11 9

TRUST FUNDS INVESTMENTS SCHEDULE.

		Stock held.	Value at date of Bequest or Transfer.	Value on Dec. 31, 1928
Alfred Davies Bequest	£1,953 0 0	Great Indian Peninsula Railway 4 per cent. Guaranteed Debenture Stock	£1,800 0 0	£1,542 17 0
Dr. Swiney's Bequest	4,477 10 0	Ground-rents (amount expended)	4,477 10 0	4,477 10 0
Dr. Cantor's Bequest	2,695 11 3	Do. do. do.	2,695 11 3	2,695 11 3
Mulready Trust	111 0 0	5 per cent. War Loan	100 1 1	114 1 10
Howard Trust	571 0 0	Metropolitan Railway 3½ per cent. Stock	510 9 5	371 3 0
Owen Jones Trust	522 3 2	India 3 per cent. Stock	423 0 0	315 18 0
Dr. Cantor's Bequest	3,273 16 6	Do. do.	2,573 10 0	1,980 13 0
	648 10 7	Bombay & Baroda Railway Guaranteed 3 per cent. Stock		671 14 0
J. Murray and others, Building Fund	20 16 4	India 3½ per cent. Stock	20 10 0	14 13 6
	38 11 0	5 per cent. War Loan	54 18 0	39 12 0
Francis Cobb Trust	255 14 1	New South Wales 3½ per cent. Stock 1930 50	250 0 0	194 6 9
Le Neve Foster Trust	140 3 1	3½ per cent. Conversion Loan	100 0 0	111 1 6
	42 2 1	5 do. War Loan	40 0 0	43 5 0
John Stock Trust	70 4 0	5 do. do.	100 0 0	72 2 0
Shaw Trust	93 12 0	5 do. do.	129 6 8	96 3 0
North London Exhibition Trust	134 17 0	5 do. do.	184 15 0	134 11 0
Pothergill Trust	272 7 6	5 do. do.	374 0 0	279 17 0
Aldred Trust	154 8 0	5 do. do.	210 17 6	153 13 0
Endowment Fund	394 7 0	5 do. do.	325 2 3	405 4 0
"Trueman Wood" Lecture Endowment Fund	920 15 8	3½ do. Conversion Loan	654 18 0	736 17 0
Sir George Birdwood Memorial Fund	734 19 0	5 do. War Loan	674 0 0	755 4 0
Russian Embassy Prize	100 0 0	5 do. do.	91 9 3	102 15 0
Maan Trust	1,028 9 2	5 do. do.	900 0 0	1,056 15 0
Thomas Gray Memorial Trust	9,047 18 9	3½ do. do. Conversion Loan	7,000 0 0	7,170 10 0
Art Congress Studentship	1,000 0 0	Canada 4 per cent. Stock	1,000 0 0	910 0 0
	112 0 0	Bengal-Nagpur Railway 4 per cent. Debenture Stock	112 0 0	86 10 0
	391 9 6	5 per cent. War Loan	398 18 7	402 5 6
		£25,410	6 0	24,945 12 10

NOTICES.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One-hundred-and-seventy-fifth Annual General Meeting, for the purpose of receiving the Council's Report and the Financial Statement for 1928, and for the election of Officers, will be held, in accordance with the Bye-laws, on Wednesday, June 26th, at 4 p.m.
(By Order of the Council),

GEORGE KENNETH MENZIES,
Secretary.

COUNCIL.

A meeting of the Council was held on Monday, June 10th. Present :— Sir George Sutton, Bt., in the Chair ; Lord Askwith, K.C.B., K.C., D.C.L. ; Sir Charles Stuart Bayley, G.C.I.E., K.C.S.I. ; Captain Sir Arthur Clarke, K.B.E. ; Sir Thomas Holland, K.C.S.I., K.C.I.E., D.Sc., F.R.S. ; Mr. P. Morley Horder, F.S.A. ; Sir Herbert Jackson, K.B.E., F.R.S. ; Major Sir Humphrey Leggett, R.E., D.S.O. ; Sir Philip Magnus, Bt. ; Sir Reginald A. Mant, K.C.I.E., C.S.I. ; Col. The Master of Sempill ; Mr. James Swinburne, F.R.S. ; Mr. Carmichael Thomas, and Lt.-Col. Sir A. T. Wilson, K.C.I.E., C.S.I., C.M.G., D.S.O., with Mr. G. K. Menzies, M.A. (Secretary), and Mr. W. Perry, B.A. (Assistant Secretary).

The following candidates were duly elected Fellows of the Society :—

Baker, W. E., London.
Bannister, William, J.P., Croydon, Surrey.
Bilderbeck, George Leslie, New London, Conn., U.S.A.
Fyfe, John Herbert, Calcutta, India.
Herdman, Ellice Bernard, Suez, Egypt.
Jeffreys, Arthur Gerald, Port Arthur, Ontario, Canada.
Kark, Victor Sais, London.
Macfarlane, Athol Herridge, M.C., Hillah, Iraq
Mackenzie, John Fraser, Nairobi, Kenya.
Powell, Lange L., Brisbane, Australia.
Rhodes, Harold, A.R.C.A., Manchester.
Sakai, Yasudiro, Tokyo, Japan.
Sampson, Charles Victor, La Paz, Bolivia.
Sumner, John, Powyke, Worcester.
Taylor, H. Stanley, Bath.
Wilson, George Heron, East Grinstead, Sussex.
Wright, Reginald W. M., Bath.
Wood, Gladstone Stanley, Chesterfield.

The resignation of Sir Alfred Yarrow, Bt., F.R.S., was accepted with regret.
The terms of the award of the Albert Medal were settled [see page 784 below.]
The number of entries for the Competition of Industrial Designs was reported.

The Report of the Council for the session 1928-29 was considered and approved for submission to the Society at the Annual General Meeting.

A quantity of financial and formal business was transacted.

THE SOCIETY'S ALBERT MEDAL.

The Albert Medal of the Society for the current year has been awarded by the Council, with the approval of the President, H.R.H. the Duke of Connaught, to Sir Alfred Ewing, K.C.B., LL.D., F.R.S., Principal and Vice-Chancellor of the University of Edinburgh, "for his work on magnetism and his services to Technical Education."

The medal was founded in 1863 as a memorial to Prince Albert, for eighteen years President of the Society, and is awarded each year "for distinguished merit in promoting Arts, Manufactures and Commerce."

PROCEEDINGS OF THE SOCIETY.



TWENTY FIRST ORDINARY MEETING.

WEDNESDAY, MAY 8TH, 1929.

PROFESSOR W. ROTHENSTEIN, M.A., Principal, Royal College of Art, in the Chair.

THE CHAIRMAN said he took it that the honour of presiding that evening had been conferred upon him largely because he had also had the honour—perhaps the greatest of all in his fairly long life—of having been an official artist during the war. It had certainly been an immense privilege for a non-combatant to go through some of the hardships of the men who had taken part in the actual fighting. He was looking forward with the greatest possible interest to hearing the lecture and to seeing the slides. If he might be allowed to say one thing for his own profession, it was the fact that for the first time, probably for 200 or 300 years, there was a subject matter in common between the artist and the public which made most of the war pictures the most significant pictures which had been produced in our own times. That was a state of things which everyone would like to see recur somehow, so that there would be that marvellous partnership again—a common subject matter which would allow people to follow works of art without thinking of the three dimensions, but sharing with the artist common human experience.

WAR AND ITS INFLUENCE ON THE ARTS.

By CHARLES FFOLKES, O.B.E., F.S.A.,

Curator of the Armouries, Tower of London.

The subject which I propose to discuss this evening has so many ramifications that I am compelled to deal only with one aspect and must perforce leave,

with regret, the influence of war upon architecture and the applied arts, the loss of priceless works of art by the destructive agency of war and the introduction of alien styles and fashions by conquerors who imported their own artists and imposed their will, political, economical and artistic upon vanquished nations.

Time also will not allow me to consider the war records of Assyria, Egypt, Greece and Rome, though each of these merits special study from which we might learn much of the military operations and equipment of past ages, a study which, in this country at any rate, has never received the attention which it certainly merits.

I shall confine myself this evening to the pictorial and sculptured military records from the thirteenth century up to the present day, and even here there is such a vast amount of important material worthy of consideration that I can only touch upon certain typical examples as illustrating the value of these records as illustrations of historical events.

The psychology of war, the reasons for its periodic outbreaks and the possibility of its prevention, must be left to abler students of the subject, but I am sure that all of us, with the exception of a few savage militarists, will agree that it is a terrible upheaval of society which must be avoided at all costs. At the same time, in considering the artistic development of the several nations of Europe we shall be obliged to admit that the history of art and craftsmanship is very definitely bound up with national history, and national history is the history of conquest and war.

Napoleon III, under whom those exhaustive studies on the history of artillery were produced, went still further, for he attributed the development of the whole of civilisation to artillery alone. Writing in 1872, after his own tragic experiences, he states, "*L'histoire de l'Artillerie est l'histoire du progrès des sciences et partant de la civilisation.*"

All pictorial and sculptured art from the eleventh century onwards was produced under the patronage of kings, princes and high ecclesiastics, and to these riches and wealth in the first instance were simply matters of land and territories, which were only acquired by conquest and were held only by strong military forces until such time as a stronger power arose and opposed them.

It therefore follows that it was only the conqueror or the ruling prince with a stabilized empire who could hold his own and establish a court as a centre of learning and of the arts, and could patronise the artist, sculptor and craftsman either by directly employing the lay artist or by founding monasteries and ecclesiastical establishments in which the miniaturist could work in safety, peace and quietness. Such great princes as the Medici, Francis I of France, King René of Anjou, Maximilian, Napoleon and the British government in the late War were conquerors, or at any rate held large possessions by force of arms, and it is to their patronage that we are indebted for many of the finest examples of the allied arts, and it is their military exploits which have inspired

artists to produce work which has its place in the history of art quite irrespective of its military value. It may be urged that some of the greatest works of art have been produced under the patronage of the merchant princes of Venice and the Netherlands, but these, I suggest, amassed their riches either by loans for war purposes or by trading, which could only be carried on in safety because it was protected by armed power on sea and on land. I only know of one instance where a beaten nation produced military works of outstanding merit. I refer to the military paintings of the War of 1870 by Edward D  taille, which as portrayals of actualities and at the same time records of military equipment, minute to the smallest detail by an eye witness who actually served in the French army, are unsurpassed.

Military paintings and representations may be broadly divided into three categories :

- (1) the religious, i.e., illustrations from the Old and New Testaments,
- (2) fables, or romantic histories, such as " The Romance of Alexander," " The Life of Charlemagne " and,
- (3) historical, as for example, " The illustrations of C  sar's Gallic War " in the " Harleian Manuscripts," the illustrated " Froissart " also in the Harleian Manuscripts, " The life of Richard Beauchamp, Earl of Warwick," the Cowdray paintings, and many others, including all the military painters of the eighteenth, nineteenth and twentieth centuries.

Taking the religious subjects first. These as I have said are mostly illustrations from the Old and New Testaments, and it is in the Old Testament that we find innumerable miniatures depicting battles of Israelites. Here the Israelites are always shown as the victors, and the same may be noticed in the illustrations of fables and historical events up to the sixteenth century, where the armies of the hero, or of the nationality to which the painter or his patron belonged, are always portrayed in the best possible light. Up to the end of the sixteenth century the artist almost invariably depicts the fighting man in the costume of his own period, and herein is most valuable double-edged evidence, especially in illuminated manuscripts, for, if we know the date of the manuscript we can be certain that the armour portrayed is of that date, but if we do not know the date of the manuscript and from other sources we know the date of the armour that is represented we can date the manuscript with a considerable amount of accuracy.

The artist from the eleventh to the sixteenth century had no antiquarian knowledge whatever. It is true that Italian painters of the Renaissance, such as Mantegna and Guilio Romano, having the remains of Roman sculpture to guide them attempted to give some sort of historical accuracy when dealing with classical subjects, but for the most part the soldier, whether he be an Israelite or one of Charlemagne's paladins, or indeed Joan of Arc, was always equipped in the armour which the artist knew and had before his eyes.

I have noted the absence of historical data in most of the early battle pieces but there are other aspects which have never received the consideration which I think they deserve. One is that all battles from the Bayeux tapestry right up to the military prints of the earlier nineteenth century show the combatants at full speed, which when we consider the cumbrous equipment of the mail-clad knight of the thirteenth century or the heavily laden grenadier of the French Imperial Guards, must have been an absolute impossibility. Another interesting detail which I do not think has ever been seriously noticed is that in all these battle-fields the combatants are shown in full armour or uniform. Occasionally we have written records of fighting men discarding their armour in order to move more easily, as in the notable and off-quoted example from the chronicles of Du Guesclin, from which we learn that at the Battle of Mont Auray in 1364 Sir Hugh Calverly ordered his men to take off their cuisses or leg armour in order to move more easily; and again we have the instance of Sir Philip Sidney and Gustavus Adolphus being killed because they had discarded portions of their armour. Very seldom, even in later years, except in pictures by De Neuville, Détaillé, Vereschagin and Lady Butler, do we find troops represented as travel-stained, unkempt and ragged. The artist of the late nineteenth century is more of a realist, but even here if we compare the finished painting with some of the sketches of war correspondents we find that there is still a portrayal of what, for want of a more polite expression, we may call the "spit and polish" beloved of the sergeant-major. The reason for this is threefold: firstly that the artist had to please his patron, who naturally desired an attractive record of his military operations, secondly with few exceptions the artist worked in his studio and had very little first-hand knowledge of the carnage of a battlefield, and thirdly, in the case of easel pictures or wall decorations he had to produce something which was inspiring and not terrifying to the public. The great military paintings at Versailles, the wall painting by Machse in the Houses of Parliament, and such pictures as Philippoteaux's "Battle of Fontenoy" all show the soldier smartly equipped with no hint of the fact that he had been marching through miry roads and fields in a long and arduous campaign.

Such works of art may be, and indeed they are, valuable records of the actual uniform and equipment, but they are of little value as accurate portrayals of the fields of battle.

Another section of our subject which I propose to touch upon is the single figure, painted or sculptured, as a record of military equipment, and here we are still faced with glaring anachronisms. St. George, who is a favourite subject for military sculptors, is almost invariably represented in the armour of the period, for to the artist and sculptor he was a symbol of courage and not a historic personage.

Joan of Arc has probably caused more artists to sin in this direction than any other military saint. I have a collection of reproductions of St. Joan,

which range from a contemporary print up to the eighteenth century, and she is invariably depicted in the armour of the period in which the artist lived. Indeed, in the eighteenth century she is shown in a long skirt with breast and back plate and three-cornered hat. The modern artist with all the resources of antiquarian knowledge and research at his command is a terrible sinner. I know of one very popular modern representation of St. Joan in which she is dressed in what is known as "Maximilian" armour, which was in vogue during the first half of the sixteenth century.

In our own time, when the whole country is studded with War Memorials of varying merit, it has always seemed to me extraordinary that St. George in fifteenth-century armour should be so popular. The equipment of the British soldier in France and Flanders with steel helmet, gas-mask, putties and sometimes fur covered jerkin is as fine a subject for decorative art as could well be imagined, and if used to the fullest extent in sculpture would provide our descendants with an accurate record of the equipment of the earlier part of the twentieth century, as Can Grande at Verona and Colleone in Venice gives us the armour of the fourteenth and fifteenth centuries, but St. George in an English provincial market town means but little to the inhabitants except that it is part of the War Memorial, and to the student of arms and armour his equipment is often distressing in the extreme.

A further aspect of our subject which deserves notice is the inspiration of war and military subjects to the artist, and this inspiration may be under one or more aspects. There is composition of men in serried ranks, as, for example, Velasquez's "Surrender of Breda," or Charles Furse's great portrait of Lord Roberts where the crowd of vertical lances gave a form of composition which could not possibly have been obtained in a peaceable subject. There is the disordered confusion of fighting men which could not be found in peacetime. There is the gorgeous colour of plumes, surcoats and standards, as in the painting of "The Battle of San Romano" by Uccello, and of course the brilliant uniforms in the paintings of the late eighteenth and early nineteenth centuries, and there is also the excuse for displaying the artist's knowledge of human anatomy in violent action.

In later years we find occasionally an endeavour to show what a terrible and bestial method of settling international disputes war is, and always must be. The etchings of Callot and Goya, though not actually depicting fighting, show the futilities and horrors of war with powerful realism, which has never been equalled, but with such terrible detail that it is inadvisable to show them as illustrations.

War paintings have been, and always will be to a large extent propaganda for the glorification of the victor and of the fighting man, but with the exception of Goya and Vereschagin we hardly ever find the real terrors of war depicted, even by competent artists of high reputation. In the great wall painting of the meeting of Wellington and Blücher by Maclise the whole of the foreground

is crammed with dead and dying, all in conventional attitudes, and with very little suggestion that they have passed through a strenuous campaign and hard fought battle, but the detail of uniform, weapon and equipment is meticulous and most valuable. It is not until we reach the middle of the nineteenth century that we find war treated with pathos, as in "The Roll Call" by Lady Butler, which in no way revolts the beholder, but simply appeals to one's sympathy.

In 1917, a powerful Committee under the British government evolved a scheme for using the work of living artists for propaganda purposes. These artists in many cases were serving in either the Navy, Army or Air Force, and they were given the choice to continue serving or to produce records of the war on all fronts which would automatically become the property of the State. The choice of artists was Catholic in the extreme: practically every school of painting was represented and as a result the Government possesses examples of the work of most of the principal painters, etchers and of a few sculptors which illustrating British art during the period of three years, is unequalled anywhere else in the world. These works of art were originally intended as propaganda to arouse the interest and enthusiasm of those at home and to attract the sympathy of neutral and allied countries, but it was very soon seen that the propaganda was of a very different nature to what might have been expected. The sole condition of the employment of the artist was that he must have seen, and possibly experienced, the subjects which he portrayed.

When we examine the subjects of the ordinary peacetime picture Exhibition - the landscapes, the peasants, the bathing ladies and the fashionable portraits, it is not surprising to find that these artists accepted with enthusiasm the commission of the Government. Here they were faced with entirely new conditions such as could never have been dreamed of before - curious effects of atmosphere, strange problems of perspective and men in unnatural attitudes, living, working and fighting in unnatural surroundings. The result of this was that the artist found himself as he had never found himself before, and will never find himself again. There was no need to rack the brains for composition or for a subject. It was there at every moment and at every turn of the road, the only difficulty was to make the choice, with the result that this great collection of pictures is unsurpassed in any nation, or at any period in the whole history of art.

I propose to divide my illustrations into groups illustrating the treatment of the subject rather than into the historical periods which I noticed at the beginning of this lecture. These groups may be broadly classed as:-

(1) *The ignorant anachronist*, under which heading we shall find the miniaturists and sculptors of the thirteenth, fourteenth and fifteenth centuries, who had no antiquarian knowledge of costume or armour of any period previous to their own.

(2) *The wilful anachronist*, that is, the artist who lived in more modern

times and could, if he had taken the trouble to make some researches, have costumed his fighting men with historical accuracy.

(3) *The pseudo realist*. By pseudo realist I mean the man who took meticulous pains to get every button, strap and sword hilt correct and yet gives one only the impression of a number of studio models posed in theatrical attitudes, but with no hint whatever that his figures are fighting desperately for their lives.

(4) *The contemporary recorder*, that is the artist who recorded what appear to be actual war conditions but of whom we have no evidence as to whether he was an eye witness.

(5) *The eye witness*, the man who saw and knew, and who had experienced the things which he was depicting.

Under this last heading it may possibly be urged that the most realistic representation of war, or in fact any operation of life, is the photograph, but there are serious objections to this. In the early days of Press photography we were satisfied that the man with the camera was on the spot, and it used to be a byword that the camera could not lie, but in more recent years, with more experience and with some of the astonishing composite photographs which appear in the Press before us, we can only be convinced that Ananias was a mere tyro when compared with the highly skilled expert photographer if the photograph, as taken, does not suit his purpose. Another objection to the photograph, particularly in treating war subjects, is that the photographer is obliged to take what he can see from his position, quite irrespective of where the sun is, what the weather conditions are and what the nature or colour of the ground may be which he photographs. The result is that very often the most important detail of his picture is lost and can never be recovered, but with the trained military artist he sees exactly what he wants to record, jots it down in a few lines and eliminates all the non-essentials.

I will now proceed to put before you my illustrations and again I must warn you that these are not chosen for their artistic value, but are shown solely as records of war operations and equipment as treated by European artists and sculptors of the last 500 or 600 years.

Under the heading of the anachronist we must in all fairness admit that there was no antiquarian knowledge or interest in the thirteenth century and the object of all religious painters was to make the Old and New Testaments alive and real to the people. The examples of this type are a battle between the Israelites and Philistines from the magnificent thirteenth century manuscript in the possession of Mr. Pierpont Morgan which shows the Israelites in full mail equipment of the period but gives the Philistines, as Gentiles, the somewhat out of date armour of the eleventh and twelfth centuries. This engraving by Deutsch about 1540 depicts the battle of Sempach fought in 1386. It is, therefore, useless as a record of the battle, but is of great interest as a rare portrayal of first aid and medical services in the field. The beautiful Easter

Sepulchre in Lincoln Cathedral shows armour also of the early fourteenth century. With regard to single military figures we have the St. George of Dijon, middle of fourteenth century, St. George of Prague, late fourteenth century, and Pisanello's St. George in the National Gallery, middle of fifteenth century, all of no value whatever as records of the possibly mythical St. George, but all most useful as examples of military equipment. The woodcut of St. Joan from "*La Mer des Histoires*" produced about forty years after her death shows a type of armour which was not in vogue at the period of Joan of Arc's military career.

We next examine the wilful Anachronists, that is those to whom historical records were available but who from pure carelessness preferred to trust to their own imagination or to their incorrect ideas of history. Here we have a scene from the *Siege of Troy* by Giulio Romano in which the Greeks and Trojans are wearing Roman armour, and that too of the late Roman Empire as shown on the Trajan Column. Next is a picture by David of the Rape of the Sabines in which the combatants are in Greek armour, all very smooth and clean with no hint of the turmoil of battle, and studied more as an exercise in composition, for the lady in the foreground has obviously been introduced to bring the two parts of the composition together. In our own time Boydell, artist and Lord Mayor of London, produced great historical "*tableaux*" as they were called which even now are used to illustrate history books and works of reference. In his version of Scene 5 Act II of the 3rd part of Shakespeare's *Henry VI*, the armour shown is of the seventeenth century and bad at that, the helmet of the King being of a type in vogue in Spain two hundred years later than the death of Henry. We will turn for a moment to St. Joan of whom throughout the ages there are thousands of representations about 75 per cent. of which are entirely misleading. A seventeenth century print shows the Maid in Roman armour, and in one of the eighteenth century she is modestly dressed in long skirt with sixteenth century sleeves, and lastly Sir John Millais, who ought to have known better, gave us St. Joan in fluted Maximilian armour which was introduced just about a hundred years after her death.

The last instance of wilful anachronism which I will mention is the very beautiful illuminated copy of Cardinal Mercier's pastoral letter, produced by the Nuns of Maredret. Now the devoted artist must have made minute researches to get the thirteenth century equipment, with which she has armed the British Expeditionary Force correct, but if she had just looked out of her window she would have seen that the present day helmet, gas mask and putties are decoratively as fine as any armour of the past and this work would have been of great historic value instead of being merely a fine example of modern illumination combined with some unconscious and unintentional humour.

Now we have the Pseudo Realist, that is the artist who has taken pains with his detail but has in most cases entirely missed the reality of war and only

suggests studio composition or at best a theatrical pageant. Philippoteaux's Fontenoy, 1745, though meticulously correct as to uniform and arms is more suggestive of a parade or inspection than of a battle. England had been fighting in Europe since 1743, so that it is hardly likely that both English and French troops would have arrived at Fontenoy in new uniforms. The same artist produced a great panorama of Waterloo. This is more realistic, but he cannot get away from the traditional convention of battle pieces. Still it is probably as near to the original as it is possible to get, but we should note that the old black powder used at Waterloo would have created such a smoke that the scene which the artist depicts could never have been visible for a moment. Heath's numerous battle pieces have no pretensions as works of art, but they do show, considerably compressed, the dispositions of troops. Maclise in his great wall painting in the houses of Parliament is frankly concerned with the filling up of a certain space with a given subject. He shows heaps of dead and dying men with no suggestion of the horror and misery of a battle-field, each figure is nicely posed and most of the faces bear an expression of sorrow or boredom rather than of agony and pain.

The Contemporary Recorders as I will call them are those who depict the battles of their own time with probably some accuracy but the conventions of art precluded them from any suggestion of realism as we know it to-day. From the Cottonian MSS. in the British Museum we have a drawing of the Siege of Caen in 1418 by the Duke of Clarence and Richard Beauchamp, Earl of Warwick, but even here we must be cautious for the manuscript was produced about the year 1480 and the armour is more of the style of the late than of the early fifteenth century. Still the artillery, ship, shields, etc., can be taken as useful records of the period. The next three illustrations are from German engravings. A sixteenth century print shows a siege of the period and Amman's print of an army on the march must, I assume, have some relation to fact, though one cannot help wondering what would happen to these troops in close array if they were suddenly surprised or ambushed. The two next pictures are from the paintings in Cowdray Castle which were destroyed by fire in 1793. They represent the Siege of Boulogne in 1544 and were produced for Sir Anthony Browne, the owner of Cowdray who with his retinue is shown on one of the paintings. They can therefore be considered accurate and contemporary records of great value. This fine drawing by Durer is exhibited to show what was probably the fighting equipment of the knight who probably discarded leg armour and horse armour when engaged in extended campaigns.

The work of actual eye witnesses shows us that to-day at any rate the battle is so widespread that, except in attacks which as a rule the artist does not see or if he does so strenuously engaged that he can take no notes, artillery fire at long range dominates everything, and the incidents, except those behind the line, must be left to the imagination. I give this illustration of a chest at

New College representing the Battle of Courtrai in 1302, because from internal evidence I feel convinced that the sculptor was present as a combatant. He places the Guild Banner of the Carpenters first when that of the Masons should have occupied that position and the fact that the only surcoats emblazoned are those of the men of Ypres held in reserve at the Castle suggests that he was a member of the Ypres Guild of Carpenters. All the French heraldry which the reserves would not see is wrong, but the banners of the French governor of the Castle where the reserves were posted are correct. I take leave, therefore, to rank this carver of Ypres as one of the earliest war correspondents. I show two illustrations of Vereschagin. He was with the Russian forces in Turkestan in 1867, in the Russo-Turkish war of 1877 and was killed on the Russian flagship in the Russo-Japanese war of 1904. The first shows an engagement in 1867 and the second is one of his powerful works illustrating the aftermath of battle. Goya and Callot have both treated this aspect of our subject, but as I have stated previously their illustrations are so terribly realistic that it would be inadvisable to show them before this society. I will now put before you the work of the artists commissioned by the Ministry of Information and the Imperial War Museum during the late war. There was one condition only made, that the artist must have actually seen the incident he portrayed and I feel sure that you will agree that each artist working in his own style with his own methods and ideals has produced historical records of the greatest value and also, if I may venture to express an opinion has added considerably to the honour and reputation of British art. The works are "The Harvest of Battle" by Mr. Nevinson, the "Attack at Dawn" by Mr. Williamson, who I believe figures in the painting, "An Advanced Dressing Station" by Professor Tonks, "The Somme" by Mr. Muirhead Bone, the "Ypres Salient" by Mr. Paul Nash, a Howitzer battery by Sir William Orpen, "The Battery shelled" by Mr. Wyndham Lewis and the historic "Entry into Jerusalem" by Mr. McBey. The last of this series are sketches actually made on the spot, but the artists' names are unknown as they have been cut out by the censor during the war period. The first of these is the tank attack at Cambrai on 30th November, 1917. Here you will see that the artist has only recorded the essential details, a selection which the photographer cannot make. I only show the photograph in the next illustration to emphasise this for the lens of the camera could not record in detail what the eye might see quite clearly. In the last illustration you will see how the sketch made on the spot is translated for home consumption. No essential factors are missing, no details are altered and yet the old tradition of the battle piece still survives, presumably because the public expects it. I have endeavoured to put before you representations of War by all Schools, solely to show how these are of value or the reverse as illustrating military operations.

What have we learned from these illustrations, and of what value are they to the historical student of military affairs? In the first place they are of

the utmost value as records of the equipment of the fighting man of all ages, but at the same time they are of little or no value as actual records from which the battles which they purport to represent can be reconstructed. Even in the fourteenth century, battle was a widespread engagement and could seldom be adequately represented as a whole, and in the nineteenth century, though some attempt was made to give correct disposition of troops in Wellington's battles, the limitations of the picture forced the artist to crowd his armies together in such a manner that both armies ought to have been all annihilated at once. Thirdly, in our own time we find that these war pictures are of value, of serious and of important value for incidents but never for battles and at the same time are careful records of the varied and mostly unauthorised equipment with which men fought under entirely unexpected conditions.

Much is being done in our schools to make history more alive and real, and illustrations in books and on wall sheets are employed in great profusion, especially in encyclopædias and works of reference. We may well ask ourselves, therefore, how far these are of value as correct representations of war operations or, indeed, of any events of history. The artist of the present day seems to be content if he shows correct costume and armour, but he neglects to study other details which, in my opinion, are of equal importance. He should investigate the weather conditions prevailing on each occasion, the position of the sun, the formation and actual soil-colour of the ground, the vegetation, the architecture of buildings, all details of equal importance to that of costume. All this needs research, but then no historical painting should be projected till minute and careful research has been exercised. There is, in this country, no excuse whatever for ignorance, for we have in the British Museum, in the Victoria and Albert Museum, and in the Royal United Services Museum, to say nothing of the thousands of war records in the Imperial War Museum, such a mass of contemporary records, both illustrative and descriptive, and all easily accessible to any one that it should be possible to recreate historical illustrations which would emerge triumphantly from the most expert criticism.

There is only one aspect which I have omitted, and that is the idealism which comes from the study of great tragedies and great suffering, and with the stupendous record of suffering and tragedy by the late John Sargent we will take leave of our subject, and we may well ask ourselves of what value to humanity is this unending record of triumph, racial enmity, cruelty and death. Mercifully this aspect of war grows less and less as the years roll on, for time softens tragedy, but what remains is what I hope and believe is the inspiration of most of the best of these battle records—the courage, the sacrifice, the patriotism and the national pride, and these attributes must always be a valued possession and splendid tradition to hand down.

In former days to those at home war was a glorious pageant and but little of its horrors was realised by those who cheered the troops going out to fight and welcomed them after their victory, but to-day war is and will be nearer to us

who, even at what is known as the "home front," in the late war had bitter experience and could realise, but in a far lesser degree, what our kinsmen were enduring overseas. Our contemporary artists, as I have shown you, were not stay-at-home men comfortably working in studios, with only an occasional air raid to disturb their equanimity. They were men who bore the heat and burden of the day, who endured the discomforts and dangers of the fighting men, and all of them gallantly performed the duties allotted to them, some winning well deserved honour in the field. These were not the men to produce highly coloured works for propaganda purposes, in which well equipped troops with colours flying defeated the panic stricken enemy. They knew too well the grim horror and had themselves walked through the "Valley of the Shadow" and if any work of art can be deterrent the records of these British artists should be valuable assets in educating the world to peace. As long as there are great tragedies in history which call for courage and endurance these subjects will always appeal to the true artist, but in the future they must be treated with knowledge, skill and respect and will illustrate and explain history, making it real and living, not merely the pageant of a by-gone age.

DISCUSSION.

THE CHAIRMAN said the lecturer had made one thing perfectly clear, namely, that war in the past had been a kind of craft or mystery which a comparatively few professional men understood, but that to-day it was something in which the whole nation was engaged and the tragedy of which was shared by all. He thought the last slides which had been shown proved that fact that men who had made records had done so from the profoundest human point of view, and not from the point of view of showing what was, after all, the false glory of war. He only regretted one thing - that the lecturer had not shown one or two of Goya's pictures, because the difference between Goya's etchings and other people's was that Goya had seen his own country invaded and his indignation had allowed him as an onlooker to do what no other artist had ever dared to do. Goya's pictures had not been known in his lifetime; they had not been discovered until after his death. If anybody wanted to see the most passionate expression against the horrors of war he recommended that they should go to the Print Room of the British Museum and look at Goya's "Disasters of War."

SIR MARTIN CONWAY said that Mr. Boulkes and himself were in charge of the War Museum. Technically he himself was in charge of it, but practically Mr. Boulkes was in charge, and all the credit for its arrangements and the work which had been done in it were due to Mr. Boulkes and not to himself. But together they took an immense interest in that institution, and especially in the collection of paintings, drawings and prints of all kinds which were there housed. In a certain sense it was one of the most important collections of works of art in the world. It was entirely unique, and probably would remain so for all time, in that it represented not merely deeds of persons who had taken part in the Great War, but the mood of the country, and the mood of the fighting forces. The artists had naturally reflected the mood of the masses which had surrounded them. From different points of view each artist had approached his subject, and his mood had

emerged. In old war paintings one never found anything of the reflection of the mood of the people; those old paintings and prints were more or less mechanical reconstructions of actual fact. The pictures in the War Museum, on the other hand, made no pretence at all to represent actual fact, but represented the mood of the men, suffering month after month and year after year, and the terrible trials which had been imposed upon all the fighting forces and, to a less degree, upon the people at home. It was that fact which made the collection of works of art in the War Museum unique and of such enormous value—a value which would increase as the years went by, because they would show to future generations the spiritual condition of a great country when submitted to a great trial. Those who had not yet visited the Gallery at South Kensington had moments of great instruction in store for them.

The lecturer had shown a very interesting historical collection of illustrations of war. Looking through ancient manuscripts depicting acts of war, it was extraordinary how little warlike knowledge the artists had. It did not matter whether it was a battle between the Israelites and the Philistines, or whether it was the Siege of Troy or Alexandria, or whatever it was, in all of them there was the same kind of merely decorative treatment of the subject suitable for the embellishment of a page, or suitable merely to illustrate the text—which they did not illustrate but which they merely adorned. The British Museum had many such manuscripts. They were usually very inefficient as illustrations of war, although they possessed the highest merit as decorative adjuncts of a book.

The lecture illustrated Mr. Ffoulkes's vast knowledge of the subject, and he was sure the audience would desire to pass a most hearty vote of thanks to Mr. Ffoulkes for his most interesting lecture.

The vote of thanks was carried unanimously.

MR. FFOULKES, in acknowledging the vote, said he did desire to impress upon students that it was really important to study these matters at the fountain head. There were records in the museums of this country which could not be equalled in any other country in Europe. It was simply a matter of writing for a ticket. The whole of the history of the subject would then be open to any student. There was, therefore, no excuse for any historical inaccuracy when such splendid records were available, of which he hoped all students would make use.

The meeting then terminated.

NOTES ON BOOKS.

THE NEW INTERIOR DECORATION. By D. Todd and R. Mortimer. London: B. T. Patsford, Ltd. 21s.

An excellent book; written with knowledge and style, well illustrated, well printed, not expensive at the price. The authors have a thesis: they have stated it succinctly. Their preliminary essay is comprehensive, and is important both as description and criticism. Interior decoration is a matter of industry as well as art, and therefore the concern of manufacturers and the public as well as of a handful of painters and dilettanti.

There is, Mr. Mortimer and Miss Todd assert, such a thing as twentieth-century "period," and whereas it is incongruous and unsatisfactory for modern people

to live and conduct their lives and businesses in *other* "period" surroundings, it is natural and right for them to sleep in bedrooms and work in studies that are one in spirit with motors, liners, aeroplanes. Le Corbusier, the Swiss architect and decorator, has said that a house must be regarded as "a machine for living in." Like him, the authors are enthusiasts for ferro-concrete, long horizontal windows, the abolition of mouldings and the frank exposure of fittings. Their photographic illustrations show exteriors and interiors by Le Corbusier, Bourgeois, Stam, Oud, Gropius, Neutra and others; and certainly, if it is right to live in accordance with a particular interpretation of the spirit of the present age, let those who can afford it get one of these architects to design their homes.

Before criticising this point of view it may be a good thing to mention that there is a very sensible bass accompaniment to the blithe treble trillings of Mr. Mortimer and Miss Todd. For they explain that it is the need for compromising between the shapes and adjuncts of old houses on the one hand, and the demands of modernity on the other hand, that has mothered the decorative art of Duncan Grant whom they regard as a great painter; indeed, a great master. Duncan Grant is a great painter, and his modern decoration is great decoration. Le Corbusier is a brilliant, enterprising architect and decorator: he is original and interesting, and so is his work: but are he and it *great*?

The half-hearted revivals of the nineteenth century are condemned by the authors: very properly. Alone, we read, the skyscraper and the Eiffel Tower stand as signs of grace in that disgraceful age. But the authors themselves confess to disappointment in the American skyscraper, which has mostly been spoilt by touches of Gothic and Renaissance character. Now this is not the only fault of the skyscraper, and its monstrosity is the only virtue of the Eiffel Tower.

The best building of the Middle Ages was too supernaturally inclined to let it rank with the best work of Greece, Rome and the Italian Renaissance: very human architecture and decoration. It looks as if the most forceful architecture and decorative art of the first half of the twentieth century is too much aiming, not at the supernatural, but at the superhuman, to be of the highest order. For the superhuman has almost everything in common with the subhuman. How uncomfortable sensitive, untidy people must feel in rooms where the most priggish qualities of metal and enamel are coldly and perfectly expressed, as in a design by Le Corbusier! The continuous reproaches of immaculate linos must be more distressing than the dust-collecting proclivities of a nice, thick, old-fashioned rug.

There are *two* New Interior Decorations. Both are important, but the more striking is the less so. The more striking, though more extreme, is not more ingenious or more thorough. On the other hand, Duncan Grant, like the great artists of the Renaissance, will refrain from no device, however old-fashioned, that he thinks will contribute to the effects he wants to produce. He is creative, and so more than a talented eclectic. In a quiet way he is Twentieth Century "period," even if at first sight one fancies that his mission is the annihilation of period. At any rate, his work is very human, in some respects the absolute antithesis of Le Corbusier. For instance, it is often done in what looks like an almost clownishly slipshod, patchy, opportunistic way: herein it is the opposite of mechanical. The best decorations for a Le Corbusier wall are abstract designs. Grant puts form before everything, but not form dissociated from all human habits and interests.

From the fact that the two schools admire one another it is fair to conclude that they have something in common; but it seems to me, none the less, that their paths are more likely to diverge than to unite, as Mr. Mortimer and Miss Todd prophecy they will do.

But the Continental mechanistic movement must not be underrated. It is sane, healthy and economical; the doubt is as to its beauty. The concluding chapter, on "Methods and Features," is of practical value. Our houses in England have a long way to go, so to speak, before they run any danger of being accused of extremism.

P. B.

TUNGSTEN; A TREATISE ON ITS METALLURGY, PROPERTIES AND APPLICATIONS.
By Colin J. Smithells. London: Chapman & Hall, Ltd. 215. net.

Metallic tungsten of a century ago was a semi-fused hard granular product obtained by reducing an oxide with charcoal at a forge or wind-furnace heat, and chemical text-books of this period usually dismiss the subject of tungsten in a few lines, terminating with some such sentiment as "no industrial applications." Some rather important industrial uses were made of the carboniferous tungsten as also of the compounds during the second half of the nineteenth century, and we may mention magnet steels, and high speed or self-hardening steels, but it was nearly the end of the nineteenth century when physicists began to realise that the true tungsten ranges close to carbon as to infusibility; the old tungsten being a highly carbonised product comparable with cast iron and owing its greater fusibility to the presence of impurities, chiefly the carbon. It was also realised that if lamp-filaments of nearly pure tungsten could be satisfactorily made and successfully used, electric lighting by the incandescent lamp could be put on quite a new basis of efficiency.

In the volume before us, Dr. Smithells gives vivid pictures of the quest for an industrially practical method of making useful filaments of tungsten, and from a theoretical or instructional standpoint we may touch on the method described at the end of p. 6 (1) Carbon filament being under electric control for heating; when in an atmosphere of hydrogen and tungsten hexachloride it becomes coated with metallic tungsten; (2) At higher temperatures in atmosphere of hydrogen, the carbon and tungsten unite forming a carbide, (3) Heating in atmosphere of hydrogen and water vapour: result a hollow or tubular filament of pure tungsten. Practice has found this system of making a kind of tungsten pseudomorph of the carbon film to be rather expensive, and has drifted towards methods in which plastic materials are squirted through a die, all but the tungsten being subsequently eliminated by suitable treatment. The plastic mixture may be an amalgam-like paste of tungsten, or an aqueous paste of colloidal tungsten (p. 7), but dextrine or starch may be used to make a paste with water and finely divided tungsten (p. 6 and cf. p. 40 as to particle size).

This Volume of VIII + 168 large octavo pages, with 156 illustrations, some as inset plates, and a good index, carries the above suggested methods from the filament to the ingot (p. 46), and from the ingot to the faggoting and swaging machines (p. 47). Next we are led to the wire-drawing machines for pure tungsten, (p. 49), and thence to pp. 143-144, where we read of copper-tungsten wires, which may be adjusted in composition for sealing into any kind of glass.

We heartily congratulate Dr. Smithells on his thorough and satisfactory textbook on tungsten, which chiefly emphasises the new work of the present century; but the earlier work from the illustrious Scheele (1781), to the filament era is sufficiently considered, and suggestions for the future are numerous and pertinent. Hence it is that every chemist, every electrician, and every metal-worker should possess a copy for reference.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 3997.

VOL. LXXVII.

FRIDAY, JUNE 28th, 1929.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.(2.)

PROCEEDINGS OF THE SOCIETY.

EIGHTEENTH ORDINARY MEETING.

WEDNESDAY, 17TH APRIL, 1929.

PROFESSOR LEONARD ERSKINE HILL, M.B., F.R.S.,
Director of the Department of Applied Physiology, Medical Research
Council, in the Chair.

The following paper was read—

THE PROPERTIES AND APPLICATIONS OF "VITA" GLASS.

By F. E. LAMPTOUGH, M.A.,
Late Fellow of Trinity College, Cambridge.

Glass is perhaps the most essential of all building materials. During hundreds of years it has been used universally for windows to admit light and keep out wind and weather, and in such climates as ours has therefore been almost vital to the development of civilisation.

Until the last few years all efforts in the manufacture of ordinary window glass have been devoted to the production at the least possible cost of large sheets without flaw or blemish, free from visible colour, and resistant to the weather. In the middle ages it was only possible to obtain pieces of glass a few square inches in area, of a greenish colour and full of defects which distorted vision; now, however, it is possible to produce sheets hundreds of times larger in area, almost colourless, of perfect surface and free from visible defect.

Whilst different compositions of glass have been developed for the manufacture of coloured glass for ornamental purposes, glass of great brilliancy

for table ware, glass with special chemical and physical resistance for laboratory workers and illuminating engineers, and glasses of very varied compositions to meet the exacting demands of optical instrument makers, the composition of window glass has only been varied in order to make its visible properties as perfect as possible.

Modern medical research has however brought to light a very important defect of ordinary glass from the health standpoint for it has been proved to be opaque to the most beneficial rays of the sun. In order to remedy this fault the lecturer made investigations in 1924 with the object of producing a new window glass having special transparency to the health giving ultra violet rays.

The scientific research involved was carried out with much encouragement from Professor Leonard Hill and also from the authorities of the London Zoological Gardens. Dr. Saleeby and others, and early in 1925 the first full scale melting was made of window glass (designated Vita) pervious to the health rays.

In order to describe more fully the special property of the glass it is necessary to touch on the physical aspect of the position. Heat, light and sound are effects which are observable at a distance from the source of energy, this energy being conveyed by wave motion in an intervening medium and the wave length determines the nature of the energy. Thus when an air is pulsating with a wave length of a few feet the ear can hear it and give the sensation of sound, the pitch of the note being determined by the wave length.

In the case of light however we are dealing with waves in the medium which also conveys X-rays, ultra violet and infrared radiations, and the electrical vibrations which are used as carriers in wireless telephony and telegraphy, all travelling with the same velocity, 186,000 miles per second.

Wireless broadcasting stations use giant waves of hundreds of metres from crest to crest, but the wave lengths of visible light are very minute and the tiny ripples of green light have a wave length of but one fifty thousandth of an inch or thereabouts. Expressed in terms of the usual Angstrom Unit (one ten millionth of a millimetre) green light would be said to have a wave length of about 5,000 Å.

To detect wireless waves more or less elaborate apparatus is necessary which may be tuned to unison with these waves and so absorb them. Our eyes can however tune to the tiny ripples of about the dimensions indicated and so detect them by giving us the sensation of light.

Newton demonstrated by the use of a prism the splitting up of white light into a band of colours or spectrum varying from violet to red. The extreme red waves have a wave length of about 7500 and the extreme violet, 4000, and the eye is sensitive to all intermediate wave lengths and distinguishes them by colour discrimination.

Beyond each end of the visible spectrum range of colours there are in the

radiation from the sun rays which can only be detected by means other than sight.

The rays beyond the red, *i.e.*, the infra-red rays, give the sensation of heat and are usually detected and measured by their thermal effects. Beyond the violet end the rays have very slight heating power and are frequently detected by photography.

A body heated to 500°C . emits radiation entirely in the infra-red. At higher temperatures the body begins to glow and its radiation comes within the red end of the spectrum so that the body appears red hot. As the temperature is raised the radiation shifts more and more toward the violet end of the spectrum as the glow becomes more yellow and eventually a white heat is reached. Some stars, still hotter than the sun, are at an intense bluish heat.

The sun's radiation corresponds to that of a body incandescent at about $6,000^{\circ}\text{C}$., and its maximum intensity is in the visible spectrum, the strength falling off in the infra-red, and rapidly in the ultra violet region.

Ultra-violet rays of very short wave-length are harmful to the eyes and skin, but we are protected from these by the atmosphere, particularly by the ozone in the upper layers, and the limit of the ultra-violet rays which reach the earth's surface is rarely below wave-length 3,000.

It is now generally recognised that the radiation which has special biological value extends from wave-length about 3,200 A.U. downwards. It will therefore be seen that the beneficial *natural* ultra-violet rays which we experience in our climate are for the most part included in the wave-length range from 3,000 to 3,200 A.U.

Ordinary glass is practically opaque to rays below 3,300 and therefore obstructs the beneficial rays. The new glass transmits radiation well below wave-length 3,000.

Fig. 1 shows diagrammatically the splitting of a beam of sunlight by a prism and indicates how the beneficial rays are transmitted by a sheet of the new glass, but are obstructed when they meet a sheet of ordinary glass.

In Fig. 2 the actual spectrum photograph is given showing that "Vita" glass transmits the health rays which are obstructed by ordinary glass.

In the photograph the range from 2,900 to 3,100 has been marked as comprising the beneficial rays, but the range from 3,000 to 3,200 would be more correct. For the purpose of the photographic test an iron arc has been used to produce the ultra-violet radiation.

The permeability of the new glass to the "vital" rays which are so valuable to life may be shown in various other ways. These rays cause sunburn and pigmentation or bronzing of the skin, and the effect frequently is nearly as marked when Vita glass is used to screen the sun as without the screen. Ordinary glass, unless very thin, practically prevents this action.

The fading of a special blue dye has been used by Professor Leonard Hill to measure the amount of valuable rays transmitted by the glass, and has

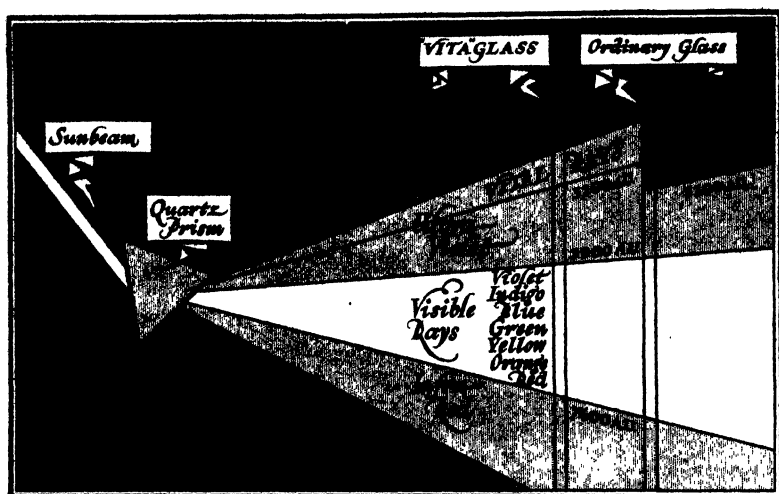


FIG. 1.

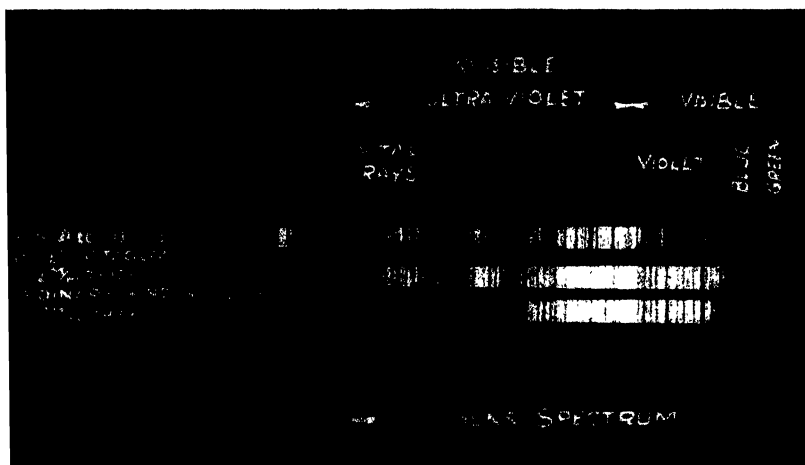


FIG 2.

shown that certain small organisms—infusoria—are killed by these rays after passage through "Vita" glass, but are completely protected by ordinary glass.

The best visible demonstration is given by the use of fluorescent substances such as uranium glass, or various dyes, which have the property of glowing

in ultra-violet rays. In making the experiment the beam from a mercury vapour lamp is filtered by a film of silver deposited on quartz or thin "Vita" glass, so that rays chiefly of wave-length 3,130 are isolated and produce the glow of fluorescence. The interposition of a sheet of "Vita" glass only slightly reduces this effect, but a sheet of ordinary glass practically extinguishes it. A photographic printing test may also be used with the same arrangement.

In ancient Egypt the sun-god Ammon-ra was paramount. The Greeks practised heliotherapy. Roman villas were in many cases equipped with solaria or sun rooms, and a face well bronzed by the sun has always been associated with an appearance of health. It was not, however, till the last decade of the nineteenth century that the earliest careful scientific work was carried out by Finsen on the use of sunlight as a healing agent, and on the artificial production of radiation of similar properties. Finsen soon realised that ordinary glass destroyed the special therapeutic property of the rays, and in his apparatus he made use of lenses of quartz which freely transmits ultra-violet radiation.

The first two or three years of the present century saw the establishment of a sun clinic by Dr. Bernhard at St. Moritz, in the Alps, where patients lay exposed without clothing to the outside sunlight. The value of this pioneer work was at once recognised by Dr. Rollier, who in 1903 set up at Leysin the first of the famous establishments which have made his name well known throughout the world, and played a considerable part in establishing the importance of outdoor sunlight in the cure of various forms of surgical tuberculosis and other diseases. Similar work has also been carried out in this country with great success by Sir Henry Gauvain and other workers.

The use of ultra-violet rays in the prevention and cure of disease forms a new branch of medical science to which attention has been given throughout the world, and the importance of these rays in furthering the general health and well-being of mankind is practically universally recognised.

Whilst intensive bare body treatment is necessary to effect the cure of serious diseases, comparatively short exposures of small areas of the surface of the body are sufficient to have valuable effects.

Rickets and surgical tuberculosis are two of the most important diseases for which exposure to the sunlight is the best possible remedy. Imperfect bone formation in children which characterises the very wide spread disease of rickets is due to unsuitable food and lack of the sunlight, which gives the body power to absorb the bone-building elements calcium and phosphorus. From tests in Manchester Dr. Leonard Hill states that "even the small amount of light in a smoky city suffices for the clothed child if out of doors all day."

If food is deficient in vitamin D, sunlight will make good this deficiency by producing this vitamin in the surface layers of the skin. It has, however, been amply proved that ordinary window glass removes from sunlight the rays which have this preventive or anti-rachitic effect.

Shortly after the introduction of the "new" glass it was proved experimentally by Dr. Leonard Hill in the case of mice fed on diet deficient in vitamin D that the glass allowed the passage of the rays from a mercury vapour lamp which prevented rickets, whilst ordinary glass obstructed the beneficial rays.

In America careful tests were carried out at Boston in January and early February, 1927, by the Council of Physical Therapy of the American Medical Association. In this research different groups of young chicks fed on defective diet were kept in separate compartments facing south and received light as follows :

- (1) Sunlight through ordinary glass.
- (2) Diffuse light of laboratory through ordinary glass.
- (3) Sunlight through " Vita " glass.

The chicks were weighed at the commencement, 21 days after hatching, and at intervals throughout the test, the development of " leg weakness " being shown by appearance and by X-ray diagnosis.

It was found that all the chicks of groups (1) and (2) developed rickets, and after 40 days the weight had increased 2.39 and 2.43 times respectively. In other words, so completely were the anti-rachitic rays excluded by the ordinary glass that bright sunlight received through it was just as ineffective in preventing rickets as the weak diffused light of the laboratory.

On the other hand, out of 14 chicks of group (3) only two showed any trace of rickets, and the weight increase was more than double that of the other groups.

The results of the above experiment, carried out in *amer*, have been widely confirmed by the experiences of poultry farmers in the use of the glass. Similar tests have been carried out in the case of rats exposed to light from the north sky through ordinary glass and through the special glass, and these have proved the presence of the anti-rachitic rays in the light from the north sky.

In Kashmir the Purdah system is the cause of a bone disease akin to rickets. From the age of eight, girls of the higher classes are shut away from the sight of men in rooms in which oiled paper is often used to obscure the windows. In the absence of ultra-violet rays a deficiency of calcium occurs which in the case of expectant mothers becomes so accentuated by the drain on the calcium of the system that softening of the bones and curvature of the limbs result. Women of the lower classes working in the open sunlight, but with much inferior food, are in perfect health.

Dr. Kathleen Vaughan, who has spent much time in investigating this disease, states " the observed facts convince me that want of light is the essential cause," and, again, " I have not seen much benefit from cod liver oil unless light is allowed."

The inhabitants of the Faroe Islands and of Iceland live on similar food, which includes much cod liver, yet rickets is prevalent among the former and absent from the latter. It is significant that the Faroes experience dense

mists of long duration, which make the climate far less sunny than that of Iceland.

Ultra-violet radiation not only assists the formation of sound bone and teeth, but also increases the bactericidal power of the blood, thus helping it to resist infection. It has recently been said that a mustard plaster will produce as much increase in the bactericidal power of the blood as a treatment with ultra-violet rays. As, however, it would be necessary for the plaster to have an area equal to one-sixth of the whole body, and for it to remain two hours in contact with the skin, it is hardly likely that any would wish to repeat the dose.

Dr. Leonard Hill has indicated in his recent book, "Common Colds," that the healthiest condition would be achieved if we could live in direct sunlight with scanty clothing, the feet being kept warm and the upper part of the body cooled by outdoor breezes. Whilst, however, outdoor sunlight is ideal under reasonable climatic conditions, modern life prevents the majority of us from enjoying this.

Office work must be carried on under conditions in which there is a protection from wind and weather, and even in the case of schools it is desirable at least to provide roofs to protect the children from the rain. "Vita" glass therefore comes to our aid in helping to give us the next best thing to direct outdoor sunlight, and makes it possible for us to have windows which at any rate will not remove the most beneficial part of natural light. The special property of the glass should never be used as an excuse for keeping windows shut when they might well be opened to admit both air and sun. In fact many successful installations with sliding roofs or windows give the fullest access to open air. The glass has already been adopted in over 180 hospitals in this country, being used particularly for roofing open-air wards and for sun lounges, etc. This glass is exclusively a British product, and it is interesting to note that its use is also extending rapidly in the United States.

Much more extensive is its use in factories, offices and private houses, where it is the means of giving some of the benefits of outdoor sunlight to those who otherwise during the greater part of the year would have little opportunity of exposure to the beneficial rays.

It is frequently supposed that direct sunlight alone contains the natural health rays and can give benefit. This is not the case, however, for the light derived from the clear sky is rich in the ultra-violet rays. The blue skyshine of the unclouded sky is due to the "scattering" of the sun's rays by particles in the atmosphere which are small compared with the wave length of light. This "scattering" is much stronger in the case of the short ultra-violet waves than of the longer visible waves and, when the sun is shining in a clear sky, a horizontal surface receives considerably less ultra-violet radiation from the direct sunshine than from the whole of the sky minus the sun. As the skyshine is much cooler than the sunshine heliotherapy can be practised by exposure

to north sky in cases where it is important that there should be no subjection to heat.

This fact therefore indicates that the use of the new glass need not be confined to the parts of a house of more or less southerly aspect, though undoubtedly of greatest value in such positions. It is, however, important when the glass is used in windows facing north that these should be large, and it is desirable to be near to the window so that light from a large area of sky may be received. In the case of rooms where the natural light is weak, the glass cannot have any valuable beneficial effect.

When "Vita" glass is first exposed to sun there is a small initial loss of transparency to ultra-violet radiation, but after about a month, a steady state is reached, and there is no further loss of permeability. In most of the numerous tests which have given such good results, the glass was installed for some time before trials could be carried out, and therefore this initial deterioration had already taken effect and the glass would not deteriorate further with lapse of time.

The idea that glass having special transparency to ultra-violet radiation must be kept scrupulously free from dirt by frequent cleaning has by some means obtained wide credence. It is certainly desirable that the glass should not become begrimed with a deposit of soot, as this not only obstructs visible light but also the ultra-violet rays to a rather greater extent. It is not necessary, however, that more than ordinary precaution as regards cleaning should be taken in the case of vertical panes, and even in the case of roofs, though occasional washing is desirable, an important beneficial effect will still be secured if, as at the Zoological Gardens, no steps are taken to clean the glass.

Very frequently the questions are asked what is the transmission or efficiency of the glass and what is its price?

The efficiency figure of the glass depends on many factors, one at least of which cannot be determined with exactitude. These include (a) the relative beneficial effect of rays of equal intensity but of different wave-length, (b) the intensities of the different wave-lengths present in the particular incident light, (c) the transmission of the glass for rays of different wave-length.

The first of these factors itself probably depends on the use to which the glass is put, *e.g.*, prevention of rickets, etc. However, it is necessary to give some rough estimate, and we shall probably not be very far out if we take as our measure of the efficiency of the glass for transmitting natural ultra-violet health rays, the percentage transmission at wave-length 3,130 (this being convenient for measurement with a mercury vapour lamp).

The glass, recently improved as regards transmission and resistance to deterioration, after reaching a permanent condition transmits in 2 m/m thickness about 65% at 3,130, which may be taken as its approximate efficiency figure. Of the 35% diminution, 8% of the original intensity is lost simply by reflection at the two glass air surfaces and the rest by absorption.

As regards cost, it may be said that at a rough estimate, if the extra cost of a fair-sized window of "Vita" glass were spread over 20 years, it would work out at about one penny per month, or one halfpenny per week would pay for a large bay window. In new buildings the extra cost of the glass is unlikely to exceed one per cent. of that of the whole structure.

The least benefit to health to any member of the family would be cheap at this price, and it must be remembered that the benefit is received with nothing to swallow, no time to be wasted, no trouble, further expense or interference with one's ordinary life. Yet a man in an office sitting bare-headed near a window of favourable aspect may receive spread over the whole year ultra-violet radiation equivalent to that received during many weeks or even months of holiday.

Transparency to ultra-violet radiation is not the only property of importance in glass of this kind. The glass must retain this transparency without important loss of exposure to sunlight, and it must be resistant to atmospheric attack. In addition, glass which is used for living rooms must be as free as possible from visible defects which would distort vision. It is possible to produce a glass of transparency to ultra-violet far beyond the limits of the sun's spectrum, but the surface of such glass becomes corroded by damp, and the material is therefore quite unsuited for windows though useful in special optical instruments.

In view of the fact that all the necessary qualities are now combined in the glass, the time may be envisaged when at least the sunny windows of all rooms, offices, and factories where people live and work will be fitted with glass which does not obstruct the most healthful rays of the sun.

DISCUSSION.

THE CHAIRMAN said the audience were indebted to the lecturer for his clearly delivered address and for his beautiful demonstrations and slides. He was particularly pleased that the lecturer had insisted upon the open window, because he himself had always been an apostle of open air and sunlight. In all the wonderful cures which had been gained by such men as Bernhard and others, it was not yet known to what extent sunlight, and to what extent open air, had contributed to such cures. That could only be determined by scientific tests exactly carried out. Children were cured of debility and rickets in such a town as Salford. They were kept all the Lancashire winter, in rain, mist and smoke, out of doors in an open shed, which was roofed but open otherwise to the air, having no artificial heat except for drying their clothes and warming their food. They were warmly clad and well fed. Those children became robust and excellent scholars. That was a very striking thing. Open air was necessary. It must not be thought that because children were given vita glass and arc lamps, and such artificial means, that that was the whole story, and that we could stuff ourselves indoors in heated places. We should not trust only to the vita glass, but we should let in the splendid air to improve the respiratory membrane and to enable us to fight infectious diseases. It was known that light had a profound influence on rickets, which was a disease

produced by want of light ; but the bones could not possibly ossify unless we had vitamin D, obtained from a substance which had now been isolated, formed from ergosterol. It had been isolated in the National Institute for Medical Research by Webster and Rosenheim. That vitamin not only prevented rickets, but was required for general health and growth, resistance to disease, and so on. It was interesting to consider what the total effect of the want of light on the whole nation was. We must not get exaggerated ideas. Lyme Regis had three times as much ultra-violet rays as Hull, and about ten times as much as Rochdale. Yet the death rate for Rochdale, 1926-27, was 14 to 16, while for the whole of the rural districts of England it was 10 to 12. If, therefore, the whole of the difference was put down to light, it was not very great. As he had said, we must not exaggerate. One matter to be settled was whether vitamin D would take the place of rays. There were other influences in light which were undoubtedly at work in healing tuberculosis, wounds and so on, but we did not yet know how much ; and we wanted to find out by a very exact series of experiments how far the new discovery of vitamin D went. Could the want of ultra-violet rays in our smoky towns be replaced by giving everybody vitamin D ? It was a powerful thing, and not too much of it must be given. Caution had to be exercised. Some experiments recently carried out in Canada showed that in order to form vitamin D, and get this anti-rachitic effect the sun needed to be above an angle of 45° to be really active. In a city like Glasgow, where for six months of the year the sun was below 45° , there was not much of that anti-rachitic power about, and what sun there was was cut out by smoke and clothes. Yet Rochdale had a death rate of 16 against 14 in the rural districts. Evidently light could be replaced to a very large extent by vitamin D. But that was not the whole of the story, and it was necessary to know what was the truth in all this business. For vita glass to be useful far more light must be got in. We should have as big windows as we possibly could. Our buildings should be altered in order to get in more light. People did not realise how little light came into the room through an ordinary window, and a great reform had to be brought about in this respect.

DR. E. J. DECK remarked that in some experiments which had been carried out at the London Clinic on the feeding of rats on irradiated food only, without irradiated bodies, it had been found that the rats had commenced to slough around the ears ; so that it looked as if one could over-feed rats on ergosterol. It had been further noted at the clinic that rats which had irradiated food and irradiated bodies did not get that peculiar sloughing of the tips of their ears which the rats which only had the irradiated food did get. He would be very glad if anybody could offer an explanation of that.

A MEMBER OF THE AUDIENCE asked if the lecturer could state what effect vita glass had on food or vegetables.

MR LAMPLUGH replied that there had been communications from people to the press to the effect that they had had considerable increases in the size of lettuces and various vegetables by using vita glass in the place of ordinary glass. From *a priori* reasons one might hardly expect that, except possibly from a slight extra amount of heat. Nothing was really known on the point. Experiments were in progress, and it was quite possible that vita glass might produce much more vitamin in fruits, tomatoes and other vegetables. It appeared to improve the growth of flowers.

DR. KATHLEEN VAUGHAN, referring to her experience in India, said that it had been found that purdah women were always ailing, whereas the class of women who worked, for instance, on the boats and who were always in the open air, never had any trouble at all. They never went into hospital for their confinements, but carried them out naturally themselves. Since she had come home she had been investigating Dr. Janet Campbell's report on maternal mortality in England, and she noticed exactly the same thing—that maternity mortality was highest in smoky, crowded cities, or in the bottom of valleys, like Cumberland and places in Scotland, and that in localities like Shetland where the women worked out of doors the mortality was practically nil, such women having twelve and fifteen children without the least trouble, and without the assistance of doctors or midwives. That had been the case until quite recently, but now that such people were becoming more civilised, having been shut up in schools cut off from light, the women were now beginning to have trouble, and doctors and midwives were needed because the natural state of things was coming to an end. Such facts had converted her entirely to the idea of ultra-violet light and to the use of vita glass in schools.

MR. P. J. WALDRAM said the Royal Society of Arts had to be thanked for having given an opportunity for attention to be drawn to a matter of the very greatest importance. It was not usually appreciated that this country led the world with reference to ordinary daylight. For many years this country had been the only one which had retained what was known as the Law of Ancient Lights—a very ancient law indeed, going back to the beginnings of civilisation. He did hope that the present meeting would be one of many in which the matter of daylight in this country would receive attention during the next two years, as in two years' time there would be held in this country a meeting of the International Commission on Illumination—the last meeting of which had taken place in America last year, when, it was extremely interesting to note, the basic recommendations of this country with regard to daylight had received the unanimous assent of all other civilised countries.

The fact of vita glass being a British invention was one which should give us great cause for pride. It was being adopted all over the world. Unfortunately the country in which it was least appreciated, he thought, was the country of its birth; especially amongst those who should be its greatest advocates, namely, architects. He himself was an architect. We were very conservative in this country. If people spoke well of a thing one could always find somebody—generally somebody eminent—who would discover occasions on which to criticise it from all possible directions. At a recent meeting of the Royal Institute of Architects vita glass had been mentioned and had been immediately strongly criticised. One criticism had been that it was not much use putting in vita glass because there was so little for it to do. That was entirely false. The less light there was left by our close and high building schemes the more it ought to be conserved, and the more vitally important it was that the workers—more especially the typists and subordinate officials who had to occupy rooms in light wells from which very little indeed of the sky was visible—should have the best light they could possibly be given. A second criticism had been that vita glass was liable to rapid deterioration. He therefore welcomed the lecturer's figures with regard to that matter. The difficulty of solarisation had been known for some time, but statements of the wildest description had got abroad. He had heard it stated that vita glass lost about 50 or 60 per cent. of its efficiency in a couple of years. He hoped the lecturer would criticise that as sheer nonsense. If architects were going to specify this

sort of glass they should be in a position to have a guarantee that it had been properly seasoned, properly solarised, and that the qualities which remained in it after that maturing process were such as were approved by the medical profession. Another criticism which had been offered to vita glass was that its appearance was not so good. That was a matter entirely for the architects. One could not object to that criticism, but he had ventured to suggest that it should be realised that vita glass was a great triumph for British science, and that architects should be as tender as they could with the inherent defects of its infancy. He felt sure that the firm who were most associated with vita glass would as quickly as possible remove from it those defects to which objection had been taken, if in fact such defects were to be found in the vita glass on the market to-day.

CAPTAIN SIR ARTHUR CLARKE, K.B.E., said he had some little knowledge of the value of vita glass not as a medical man or a scientist, but as Chairman of the Seamen's Hospital Society. He wished he could show the audience the wonderful organisation there was at Bramshot, which was under the charge of Sir Henry Gauvain and Dr Wood. That organisation was a hospital for seamen suffering from tuberculosis, and he could vouch for the wonderful effects of open air and vita glass on those cases. He desired to ask the lecturer whether he would recommend vita glass above open verandahs, the men lying on their couches, or merely pure sunlight. He had seen the men so brown that he had scraped them as he did not think the colour was natural, and he would like to know whether that was caused by the vita glass or the pure sunlight.

The lecturer had cleared up one point which had always puzzled him. He had gone to sea fifty-seven years ago as a small boy in an East Indiaman. The food had been bad beyond compare. Yet the whole ship's company had been extraordinarily healthy, despite bad food and having to work anything from sixteen to twenty hours a day in wet, cold and freezing weather. Probably the ship's company had been so healthy because they had always been working in the open air.

MR. L. WARD said he had been hoping the lecturer would have given some statistics showing the benefits to factory workers where vita glass had been introduced. It would be a good thing to keep records in those works in which vita glass had been installed. It was quite a common custom in many works to lime wash the windows and the fanlights during the summer months, and he wondered what effect that would have on vita glass. He presumed it would nullify its effects.

A MEMBER OF THE AUDIENCE said he gathered the lecturer did not advise the use of vita glass for north lighted windows. One gentleman had suggested that it should be used for light wells. But would vita glass be justified for light wells if it was not justified for north lighted windows?

DR. ALBERT EIDSON desired to mention that the difference between ultra-violet glasses and ordinary window glass was that the former transmitted a range of from 3,300 down to 3,000 Angstrom units. That was a marked difference. Would it be right to assume that those 300 Angstrom units were the only vital rays which affected health and produced the marvellous results which had been described in animal experiments? Animals are covered with fur and the actual amount of skin exposed to the rays, therefore, is very small. Another thing which had to be borne in mind was that the actual quantity of ultra-violet rays necessary to produce the anti-rachitic substance was very minute. So far as animals were concerned, the longer rays—rays beyond the 3,300 region—which

would go through window glass with just as much ease as they would go through any ultra-violet light glass, had important biological action and until the facts had been clearly proved on a firm scientific basis, and until it was discovered which factors were really responsible for the effects obtained, it was not justifiable to spread too widely the advantages of a glass which was really only in a very early and experimental stage of development. The cures which had been made were due to a combination of open air and light, and it was not yet known how much of the cure was due to the open air and how much to the light, nor even how much was due to heat, or to visible rays or to ultra-violet rays. Was it justifiable, therefore, to say that every piece of window glass ought to be scrapped and that vita glass should be used throughout the country on the evidence available at the present moment?

THE LECTURER, in reply, said with regard to the matter of the appearance of the glass, the gentleman who had raised the point had probably based his remarks on the appearance of the glass in its very early days. At the present time its appearance was exactly the same as that of ordinary glass. It was impossible to tell the difference on a visual inspection. The same gentleman had also raised the point of deterioration. Apparently the source of that rumour was the Bureau of Standards in America, which had stated that solarisation was "complete" in a month. What the Bureau of Standards had meant, however, was that the fading process went as far as it would go in about a month's time. Many people had taken that to mean that the glass solarised or faded to nothing, and that all its valuable properties had disappeared, after a month. It was very important that that misunderstanding should be cleared up. The lecture experiments had been conducted with vita glass which had been completely stabilised by long exposure to light. As regards the question of visible defects, vita glass was now indistinguishable from ordinary plate and sheet glass except by its whiter colour.

Statistical records in factories were very hard to get, because it was difficult to get exactly comparative circumstances. Lime washing of the glass would detract very considerably from its properties.

No trouble could arise with regard to the influence of vita glass on eyesight as the glass did no more than give the effect of natural outside light.

He had not said that vita glass was no good for north lighted windows. What he had stated was that in the case of north windows it was not so valuable as in sunny windows. The windows should be large and a person should get reasonably close to them in order to gain benefit from a considerable expanse of sky.

In connection with the question as to whether human beings were subject to the same wave lengths as animals, the lecturer said that it was rather difficult to expose one set of children definitely to bad conditions in order to compare them with a set of children under good conditions, but there was a great deal of indirect and some direct evidence as to the incidence of rickets in the absence of ultra-violet radiation. The blood was more or less similar, he supposed. There was no question whatever in the case of rats and chickens that ordinary glass absolutely stopped all rays which had the property of giving protection against rickets, and therefore in the case of natural light the anti-rachitic rays must lie between 3,000 and 3,300 A.U.

In conclusion, he desired to say how very important had been the encouragement given by Dr. Hill in the early stages of investigations when most other people had but taken little interest in the matter.

A hearty vote of thanks to the lecturer concluded the meeting.

NOTES ON BOOKS.

THE FINISHING OF JUTE AND LINEN FABRICS. By Thomas Woodhouse. London : MacMillan & Co., Ltd. 15s. nett.

The wide range of subjects within the purview of this valuable text book are indicated in the preface, and give a clear idea of the complexity of the work included in operations apparently so simple as the finishing of jute and linen fabrics.

Stripped of technicalities the essential function of these processes is to treat piece goods woven from flax or jute yarns so that the appearance shall be improved, and the serviceability enhanced, without impairing the utility and durability of the fabric. Any process which departs from this basic principle violates the obligation conferred on the finishers by detracting from the real value of the material handled.

Linen must be pure white, smooth in surface, carefully lapped and with perhaps a pretty picture gummed outside the piece to attract potential buyers. Housewives have ceased to ask what sacrifices in strength have been made by processes which involve the use of chemicals, severe beetling, and vast pressure in the mangle in order to secure the desired results. In this way the life of the fabric is probably halved.

Before the mechanical era, linen was spun and woven by hand ; the yarn was boiled and the cloth was spread out on grass to improve the colour. Such linen, after several years of use, acquired a whiteness and finish which, if not up to modern standards, satisfied the consumer, both as regards appearance and durability, and there were no public laundries to rend and wear out garments.

The author explains how the simple cleansing process is still used largely for the heavy canvas, tents, ducks, and so-called brown cloth, and for materials used for packing purposes, where strength is of all importance and colour immaterial. His definition of finishing makes clear the desired end

This is tersely described thus in Chap. IV p 26 -

" The fundamental principle underlying all these finishing operations seems to depend upon the fact that cellulose, in general, and therefore all vegetable fibres, retains the form and appearance that is imparted to it while in a moist or damp condition, provided this form is fixed by the immediate drying of the fabric." while three conditions are stated as necessary for the successful finish of a cloth made from yarns of vegetable fibres :

1. A sufficient percentage of water in the cloth
2. Means of imparting different pressures for the purpose of flattening the yarns in the fabric to the proper degree.
3. Sufficient heat rapidly to evaporate the excess of moisture added in the dampening process."

The first of them raises a most important subject. Upon the percentage of water naturally contained in fibre depends its strength. A point is reached where the fibre is in perfect condition for spinning or weaving, but no scientific data have hitherto been evolved, and the factor varies according to season and to climate. That certain districts such as Belfast, Fifehire, Ghent and Lille have successfully established linen manufacture depends, not on fortuitous chance, but on favourable climatic conditions. The former is famous for its bleaching and finishing, and the aim of the " finisher " throughout the world is to emulate the perfection there attained.

The author alludes to the addition of moisture in order to protect the cloth from

the evaporation due to the generation of intense heat during the finishing process. Here is direct evidence of the damaging effect on the fabric but public demand must be satisfied and it is not within the scope of the author's work nor of this critique to suggest the education of the consumer so that he or she may demand the finish which will conserve the natural strength and beauty of the original fabric. This raises an important issue whether a manufacturer should apply the acid test of utility to the choice of processes trusting to the buying public being trained to appreciate and support the effort.

It matters less in the case of jute where a smooth surface is essential for bagging articles like flour and coffee when loose fibre would injure the contents of the sack. Moreover jute bags are frequently used but once.

The chapter on packing contains useful hints to other industries where tight pressing of materials either raw or manufactured is required to secure a reduction of freight on long ocean voyages.

Bag and sack cutting and marking machinery is treated at some length and should provide valuable reading for a wide range of readers outside jute and linen centres. Bags are now made all over the world and binder twine makers for example in U.S.A., Canada, and European countries will find this text book a useful addition to their libraries.

The process of starching calls for more than mechanical treatment research work might here be well applied to a study of starch and an application which will avoid mildew and staining in damp and tropical climates.

The last chapter pays a tribute to the high mechanical skill which has evolved types of machinery capable of reproducing embroidery and hem stitching once exclusively the product of hand labour. Our shop windows bear testimony to the successful application of this art which gives promise of a revival in the demand for linens so sorely needed at this time.

Mr. Thomas Woodhouse has exhaustively treated his subject from every standpoint and his illustrations and text provide a hand book which should prove of great value to men employed in this line of industry enabling them to acquire a sound foundation in the technique of their trade such as they could scarcely hope to attain after many years of practical experience in the factory. Nothing but pride is due to the effort which succeeds in providing a text book which enables a young man to acquire in advance such wide knowledge of general practice as a foundation for the acquisition of practical experience in any particular class in which he may specialise.

The book is written in a style that all may understand. It would be impossible to improve on the illustrations and the paper and make up are of a quality to stand duly usage. The reference to machine makers' names should prove helpful especially to foreign students.

OLD GLOUCESTERSHIRE CHURCHES. By W. Hobart Bird. London: J. Burrow and Co. Ltd. (London) 1928.

We have already noticed in this *Journal* a very interesting book by Mr. Hobart Bird on the mural paintings in the Gloucestershire churches. Mr. Bird is a learned lover of this county which among its rolling hills and in its bluish villages maintains that old world atmosphere which is now always often involved and so much less often found.

This concise guide the author tells us was largely compiled for motorists. It is to be hoped that the people who in increasing number take the road every fine week end will also in increasing numbers give themselves in architectural

objective, and not merely content themselves with the satisfaction of eating up so many miles of highway—and the usual third-rate meals with which our inns provide their guests. Even the horseradish for our beef to-day mostly comes out of bottles.

In Gloucestershire, as Mr. Bird says, the ancient churches include in their number good examples of every style of English Gothic. Motor pilgrims could have no better ground for the study of Gothic architecture and of the intimate history of the middle ages, bound up as this was with things ecclesiastical. To them Mr. Bird's book would be an ideal guide, for the details it gives are at once instructive to the novice and informative for the connoisseur.

A useful introduction mentions the chief features embodied in Gothic churches, naming their relevance to religious practices and explaining the opportunities they offered to the artists and craftsmen of former days. In sculptured tympana, carved pulpits, wall-paintings and brasses, the Gloucestershire churches are rich. Screens, rood-lofts and fonts of interest abound; there are many stone effigies, and two of wood dating from the thirteenth century. Puritan iconoclasm, fortunately, spared some of the wonderful stained glass in the county; "the great East quire window of Gloucester Cathedral is said to be the largest in existence." And not only the largest, but a very fine one.

Plate 9 exhibits some interesting contrasts. The Chipping Campden altar tomb, with its Corinthian columns, presents its own contrasts, for it was set up in that early renaissance period of transition which gave us Audley End, Burghley, and other great houses which may or may not have been built by Thorpe. In his classical resting place lies the effigy of a mediæval knight, his arms cut in relief on a pediment somewhat too steep for the proportions of the tomb as a whole.

What looks queerly like mosaic in the photograph of the chancel at Hampnett is really modern stencilling, deplored by Mr. Bird as interfering with due appreciation of the architecture, which has all the integrity of the best Norman work.

The church at Deerhurst is not only Saxon, but has a handsome tower, illustrated on Plate 3, and a font, Plate 11, "the best preserved and most ornate Saxon font in existence." The fine fifteenth century tower at Yate is one of not a great number of Gothic towers which by their proportions really contribute to the formal excellence of the church or other building of which they are a part. At Princeton University in America there is a kind of neo-Gothic tower that splendidly conveys an impression of size and dignity; few are as exquisite as those at Magdalen College and Yate.

Oddington, which figured prominently in Mr. Bird's book on mural paintings, has besides its celebrated "doom" a Jacobean oak pulpit, Plate 11, and a mass-dial on the porch wall.

Curiously enough Mr. Bird says of the gargoyles at Winchcombe that they are "unbeautiful," while presenting three of them to his readers. Gargoyles play an important part in the history of caricature, and like caricature they can have æsthetic beauty. Even to those prompted by a most secular desire to ridicule and distort the human countenance did the church thus offer their opportunity. The forty gargoyles of Winchcombe are not to be brushed aside, and perhaps not to the present reviewer alone would be one more incentive to spend a holiday looking at Gloucestershire churches.

This is indeed a most admirable little book, and it would be improvident to travel without it in the region Mr. Bird knows so well and serves in more ways than one.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 3998.

VOL. LXXVII.

FRIDAY, JULY 5th, 1929.

*All communications for the Society should be addressed to the Secretary, John Street,
Adelphi, W.C. (2)*

NOTICES.

INDIAN SECTION COMMITTEE.

A meeting of the Indian Section Committee was held on Wednesday, June 26th to consider the arrangements for meetings of the Section during the forthcoming session. The following were present : -- Sir Reginald Mant, K.C.I.E., C.S.I., in the Chair ; Sir Charles H. Armstrong ; Lord Askwith, K.C.B., K.C., D.C.L. ; Sir M. M. Bhownaggee, K.C.S.I. ; Sir Atul C. Chatterjee, K.C.I.E. ; Sir Thomas H. Holland, K.C.S.I., K.C.I.E., D.Sc., F.R.S. ; Brig.-Gen. Sir Percy M. Sykes, K.C.I.E., C.B., C.M.G. ; Major H. Blake Taylor, C.B.E. ; Mr. Carmichael Thomas ; Dr. J. A. Voelcker, Ph.D., F.I.C. ; and Lieut.-Col. Sir Arnold T. Wilson, K.C.I.E., C.S.I., C.M.G., D.S.O., with Mr. G. K. Menzies, M.A. (Secretary of the Society), and Mr. W. Perry, B.A. (Secretary of the Indian Section).

DOMINIONS AND COLONIES SECTION COMMITTEE.

A meeting of the Dominions and Colonies Section Committee was held on Wednesday, June 26th, to consider the arrangement for meetings of the Section during the forthcoming session. The following were present : -- Major Sir Humphrey Leggett, R.E., D.S.O., in the Chair ; Lord Askwith, K.C.B., K.C., D.C.L. ; Rear-Admiral James de Courcy Hamilton, M.V.O. ; Sir Thomas Holland, K.C.S.I., K.C.I.E., D.Sc., F.R.S. ; Major H. Blake Taylor, C.B.E. ; Mr. Carmichael Thomas, and Lieut.-Col. Sir Arnold T. Wilson, K.C.I.E., C.S.I., C.M.G., D.S.O., with Mr. G. K. Menzies, M.A. (Secretary of the Society) and Mr. W. Perry, B.A. (Secretary of the Dominions and Colonies Section).

PROCEEDINGS OF THE SOCIETY.

ANNUAL GENERAL MEETING.

The One Hundred and Seventy-fifth Annual General Meeting for the purpose of receiving the Report of the Council and the Financial Statement for 1928, and also for the election of Officers, was held in accordance with the Bye-Laws, on Wednesday, 26th June, at 4 p.m. SIR GEORGE SUTTON, Bt., Chairman of the Council, was in the Chair.

THE SECRETARY read the notice convening the meeting, and the Minutes of the last Annual General Meeting, held on June 27th, 1928.

THE SECRETARY then read the following :—

REPORT OF COUNCIL

I. --ORDINARY MEETINGS.

The One Hundred and Seventy-fifth Session of the Society was opened by the Chairman of the Council, SIR GEORGE SUTTON, who chose as the subject of his address " Fifty Years of British Industry." Among the many changes that have taken place during this period none is more striking than the increase in the scale upon which enterprises are now conducted—a tendency which is still being accelerated as large firms amalgamate and groups are established within particular industries. Some of the effects of this tendency were illustrated by the Chairman from the Cable Makers' Association, in the formation of which he has played a leading part. Amalgamation secures greater economy in production, management and salesmanship, greater financial stability, and a firmer hold over raw materials and the conditions of sale for the final products. Perhaps an even more important point is its bearing on research. Some idea of what can be done in this way by a great firm was given in a paper read by Mr. Percy Dunsheath in 1926, entitled " Science in the Cable Industry," when he described the research department of the firm over which Sir George Sutton presides. A task of this magnitude can, of course, only be undertaken by a large and wealthy undertaking. The Chairman also referred to the changes brought about in the last half-century in the relations between employers and employed and the efforts to secure peace in industry, and he described perhaps more forcibly than they have ever been described before—the ideals which inspire the man of affairs to build up great industrial or trading concerns.

MR. OMAR RAMSDEN, in his paper, " English Silver and its Future," referred to what he had recently seen in half-a-dozen European capitals—splendidly appointed shops full of beautiful silver, which formed a striking contrast to the stereotyped and uninteresting displays which appear in many British shop windows. He is of opinion that we are in too much of a rut,

and content to serve up reproductions or re-adaptations of antiques instead of encouraging a style founded on our national traditions, but developing naturally on fresh lines. Although taking a somewhat gloomy view of the present position of English silverwork, he is far from pessimistic as to its future. We have many admirable artist-craftsmen amongst us, and he thinks that if they are given a chance and if "artist, designer, master and man" will consent to sink their differences and pull together, this country may yet regain her position as a leader in the world of applied art.

"Forestry in Sweden: its Importance to and Influence in Great Britain" was the title of a paper by PROFESSOR E. P. STEBBING. The total forest area of the country amounts to about 58 million acres, and timber and paper pulp bulk very largely in its exports. The paper gave an account of the administration of the forest lands and the legislation dealing with them, and then proceeded to describe methods of sylviculture, including the planting, thinning and felling of trees. Professor Stebbing urged that foresters of this country might profit greatly by studying forestry management in Sweden, and he specially urged the desirability of making experimental plantations on a considerable scale by direct sowing instead of by the costly plantings which are so widely adopted in Great Britain.

The value of London's imports and exports in 1926 reached the prodigious total of nearly £702,000,000. How this merchandise is dealt with was described by MR. J. H. ESTILL in his paper, "The Port of London." About 25,000,000 tons of goods annually enter the Port, of which the water area in the docks is 720 acres with 36½ miles of quay. Particulars were given of the London, Surrey Commercial, West India, Millwall, Royal Victoria and Albert, and King George V Docks, and of the most recent developments which are now taking place at Tilbury. The vast warehouses controlled by the Port of London Authority were also described and many interesting figures were given to illustrate the amount of trade in different commodities. A remarkable illustration was given of the effect of fashion on trade. A few years ago ostrich feathers of the value of some £3,000,000 passed each year through the warehouses. This trade is now practically dead, and its place has been taken by that in silk stockings.

A great deal of public interest was attracted to the paper "Fuel for Ships," by SIR EUSTACE TENNYSON D'EYNCOURT, in which attention was drawn to the possibilities of pulverised coal. The depressed condition of the mining industry in this country, and the enormous loss of markets which it has recently suffered make it necessary that no stone should be left unturned in finding uses for what has long been one of the principal sources of our national wealth. So far as fuelling and furnace feeding are concerned pulverised coal shares many of the advantages of oil. Much research has been carried on and is still proceeding as to the use and storage of powdered fuel. Sir Eustace summarised the results of this work and came to the conclusion

that, if the ratio of the cost of coal to that of oil remains as at present, the improvements that are rapidly being made to use coal and steam in the most economical manner should lead to a very considerable demand for pulverised fuel. A great deal of spade work, however, still remains to be done in devising the best methods of conveying the coal into ships and of handling it when on board.

"Applications of Electricity to Medical Practice" was the title of a paper read by MR. G. G. BLAKE, who in his capacity as Hon. Radiographer in charge of the X-ray Department of the Star and Garter Home for Disabled Soldiers and Sailors, has had a very wide and varied experience of this subject. After touching on the uses of electricity in ordinary X-ray work for the detection of injuries, etc., the employment of ultra-violet rays for general and local treatment of diseases and the introduction of medicines into the body by electricity, Mr. Blake demonstrated the methods of measuring and recording human emotions by means of the thermionic reflexometer; he also showed how it is possible to localise exactly the position of such a foreign substance as a bullet in a human body by means of stereoscopic radiography, and he described the action of currents of high potential in therapeutics. The paper was illustrated by a large number of practical demonstrations, which conveyed a striking idea of the many ways in which electricity is now being employed in medicine and surgery.

It is estimated that five-sixths of the smoke discharged into the atmosphere of London is of domestic origin. The purification of this atmosphere is therefore mainly a domestic problem; while considerable improvement has taken place during recent years, much remains to be done. PROFESSOR CHARLES R. DARLING, in his paper, "The Domestic Smoke Problem - a Practical Solution," described some of the latest kinds of smokeless fuels and the most up-to-date methods of burning them. The Englishman loves his bright open fire, and most medical men agree that it has far more than its æsthetic virtues to justify it. Recent research has solved the problem of kindling and burning coke in an open fireplace, and other solid smokeless fuels are now on the market. Most of these were described in the paper, and their comparative costs were discussed. The lecturer urged that in the designs of all new houses the ordinary coal fireplace should be removed in favour of smokeless fireplaces. In this way a great advance would be made towards abating the smoke nuisance.

A somewhat woeful picture was painted by SIR HENRY MIERS in his paper, "Museums and Education," of the state of many of our provincial museums. Overstocked with heterogeneous collections of "curios" dumped upon them by people who have no further use for them, these unhappy places are filled with cases of moth-eaten birds and beasts, odds and ends of shells and minerals and what not. So far from playing any part in the life of the towns which they cumber, many of them are hardly known to the inhabitants. Depressing

as the description is, one knows that in many instances it is only too true. And yet, as must be obvious to every one, there are immense educational possibilities in museums. The problem is--how to make the most of them? Get rid of the rubbish, would seem to be the first step. Accept only with discrimination, and try above all things to bring your museum into some relation to the interests of the town in which it is situated. If among your exhibits you can illustrate the history and development of some local industry your museum will have real interest and value for those who visit it.

Under the Trueman Wood Trust, which was established to commemorate the long services of the late Secretary, twelve annual lectures have now been delivered, and they form a remarkably brilliant series. The list is as follows :--

- "Discovery and Invention," by Sir Dugald Clerk, K.B.E., F.R.S.
- "Glass and some of its Problems," by Sir Herbert Jackson, K.B.E., F.R.S.
- "Sources of Power, known and unknown," by Sir Oliver Lodge, F.R.S.
- "The Present Position of Research in Agriculture," by Sir Daniel Hall, K.C.B., F.R.S.
- "Long-Distance Radio Telegraphy," by Professor (now Sir) J. Ambrose Fleming, F.R.S.
- "New Methods of Crystal Analysis," by Sir William Bragg, F.R.S.
- "The Outlook in Chemistry," by Sir William J. Pope, K.B.E., F.R.S.
- "The Stability of Atoms," by Professor Sir Ernest Rutherford, F.R.S.
- "The Modern Note in Industrial Art," by Sir Cecil Harcourt-Smith
- "The Progress of Economic Entomology (with special reference to Australia and New Zealand)," by Professor R. J. Tillyard, F.R.S.
- "The Wider Aspects of Cosmogony," by Sir James H. Jeans, F.R.S.
- "The Vibrations of Railway Bridges: an Example of Co-operative Research," by Sir J. Alfred Ewing, K.C.B., F.R.S.

The very high standard of excellence set up in this series was more than maintained by SIR ALFRED EWING. He gave a masterly summary of the work of the Bridge Stress Committee, a body which has been investigating for the last six years "an old and puzzling problem of engineering--what is called the 'impact' or dynamic action of a train moving at high speed over a railway bridge." Apart from its importance from the engineering point of view, the research had a special interest as a piece of team-work. Under the auspices of the Department of Scientific and Industrial Research, it brought together the British Railway Groups, who not only contributed financial help, but also provided all the practical facilities necessary for conducting the work, and many engineers of experience and experts in theory. The principal problem before the Committee was to investigate what is known as the "hammer-blow"--in other words, the periodic variation of the vertical force exerted on the rails by the locomotive. Over fifty bridges, of spans ranging from 16½ feet to 345 feet, were tested, a large variety of locomotives being run over them. The results were most carefully recorded by mechanical means, and the relations between the amount of the hammer blow and the amount of cumulative oscillation set up in the bridges were thoroughly

investigated. The results obtained by the committee have rationalised the treatment of a very difficult problem, and should prove of the utmost value to all railway engineers.

In his paper, "The History of the Development of Fast Dyeing and Dyes," MR. JAMES MORTON related a story of apparently insuperable difficulties triumphantly overcome. Up to 1914 the manufacture of Sundour fabrics had come to depend almost entirely on Germany for certain dyes, especially the yellows and blues. The outbreak of war suddenly stopped the supply of these essential products, and the business was seriously threatened. Mr. Morton, however, rose to the occasion. With the aid of his chemical staff he traced the synthesis of two very obscure dye-stuffs, and in 1915 they actually produced for the first time in this country Indanthrene Yellow and Indanthrene Blue. In the most favourable circumstances this would have been a very brilliant feat, but when the circumstances of the time are taken into account—the extraordinary difficulty of obtaining any raw materials and apparatus, and the patriotic necessity for carrying on at the same time the manufacture of such vital supplies as army blankets—the triumph becomes heroic. Further successes have in recent years been placed to Mr. Morton's credit—most noticeable, perhaps, being the production of Caledon Jade Green. The paper disclosed one of the greatest industrial romances in the history of this country, and one which was hitherto known only to a few.

"East Indian Copals and Damars" was the title of a paper by Mr. A. F. SUTER, who gave the latest information on the production of these materials gathered during a recent prolonged tour in the East Indies. Macassar or Manilla copal is derived from a single plant, the *Agathis alba Foxw.*, which occurs most frequently in the Dutch East Indies, the Celebes, the Moluccas, Borneo, Sumatra and New Guinea. Copal is the natural exudation from the bark of this tree at places where it has been injured. The native methods of tapping the trees were described, and the measures which have been taken by Government administration to prevent their destruction by over-tapping. After the copal has been collected the next step is to grade it, which is mainly done by women, native or Chinese. Four points have to be borne in mind in the grading; hardness, colour, purity and size. Until recently copals were exclusively employed in the manufacture of varnishes. Synthetic resins, however, are now coming into vogue, and the natural products seem to be losing favour in some quarters; but Mr. Suter believes that, given accurate standardisations of the copals, they will hold their own against this competition.

A question of considerable importance to fruit growers was discussed by MR. CECIL H. HOOPER in his paper, "The Study of the Order of Flowering and Pollination of Fruit Blossoms applied to Commercial Fruit Growing." In planting orchards, whether of apples, cherries or other fruit, it has long been customary to mix the varieties, and also to keep bees in the near neighbourhood,

and recent research has proved the value of both practices ; but at the same time care must be taken to ensure that the varieties selected should flower at the same time : otherwise it would be impossible for the one kind to fertilise the other. Mr. Hooper has for many years carefully studied the question as to which varieties of fruits should be planted together, and the results of his observations were set forth in a number of valuable tables.

The remarkable hydro-electric development which is now being carried on in Ireland was described by MR. GEORGE FLETCHER in his paper, "The Shannon Scheme and its Economic Consequences." The Shannon is the longest river in Ireland with a catchment basin of over 4,000 square miles. The power house is situated at Ardnacrusha, a few miles above Limerick. The three turbines to be installed will have an output of 38,600 h.p. The current will be distributed by means of overhead high-tension transmission lines over nearly the whole of the Irish Free State, and the erection of these lines is now in a very advanced stage. With regard to the economic consequences of the scheme, Mr Fletcher pointed out that the primary economic need of the Irish Free State is cheap electric energy for lighting and power purposes. Although it is not possible to state at present to what extent the supply will be utilised in agriculture it is hoped that, with adequate propaganda, the farmers will be induced to realise the assistance that they can derive from it, and further there appears to be reason to expect that new industries which require cheap power may be induced to start in the country.

The inauguration of broadcasting six or seven years ago at once created an enormous demand for "a powerful electrical instrument which should be capable of imitating at a moment's notice the human voice, a violin, a tinkle, a crash, a piano, a drum, or a complete orchestra." MR. R. P. G. DENMAN, in his paper, "Loud Speakers and their Development," summed up the situation as it stands to-day. The immense advance that has been made recently was demonstrated by the collection of loud speakers shown at the meeting. The construction of each of these was fully described, and its characteristic features discussed. Admirable as these latest instruments are, a great many scientific workers are engaged in bringing them to still higher perfection. With the enormous financial resources of the gramophone and motion-picture industries to call on, it is probable that striking developments will be made in large auditorium instruments, and that the loud speaker used for domestic purposes will either retain its present form or else will gradually give place to small-scale examples of the larger types.

"Commercial Art" was the subject of a paper read by MR. TOM PURVIS, himself one of the most successful and brilliant of our poster artists. The relations of the commercial artist to the firm for which he works were discussed in some detail. Whilst claiming for the artist a reasonable amount of liberty in the actual carrying out of his design, Mr. Purvis made it clear that he ought always to bear in mind the object for which the poster is produced, and

work in the closest touch and sympathy with the commercial side of the firm : the poster, in short, should be the result of close team-work between the artist, the manufacturer and the salesman. Passing on to the design and execution of the poster, the lecturer discussed the uses of colour, and the importance of getting a broad effect which should convey its message instantaneously to the passer-by. To achieve this it is often advisable to omit all but the boldest features, a practice which is followed by the most successful poster artists of to-day.

In dealing with the subject of "Modern English Architecture," PROFESSOR A. E. RICHARDSON threw on the screen a large number of photographs of buildings to illustrate :—

- (a) Commercial architecture—offices, banks, warehouses, factories, transport buildings.
- (b) Housing—town and country houses, cottages, farms, etc.
- (c) Civil—post offices, town halls, schools, bridges.
- (d) Religious buildings—cathedrals, churches.

With regard to (a), we have yet to devise the efficient factory, the attractive city office, the best form of garage, and the right type of bank, the last of which is generally a classical building bedizened with unnecessary ornament. The housing question has evolved a new cottage style for villages and garden cities, and some of the pictures shown represented a very successful grouping of pleasant houses. When discussing group (c), Professor Richardson paid a handsome tribute to H.M. Office of Works under whose auspices many admirable post offices have been erected in various parts of the country. He also drew attention to the new steel bridge at Newcastle-on-Tyne, which he characterised as a thing of beauty. By way of comparison, a number of slides were also shown to illustrate recent developments of architecture in Denmark, Sweden, Germany, France, Holland and America ; and in conclusion Professor Richardson read a short imaginary paper, supposed to be delivered a century hence, in which he referred to the masterpieces of some of the best architects of 1929 and threw out suggestions as to the way in which architecture and life will have developed in another hundred years.

The main purpose of MR. GEORGE HOWARD NASH's paper, "Some Modern Aspects of Electrical Communication," was to make known to those not familiar with recent developments some of the problems that arise on very long telephone connexions, the means adopted for reducing or overcoming such difficulties, as "attenuation" or "frequency distortion," "phase distortion," "echoes" and "interference," and to explain how a number of communications can be made simultaneously over a single pair of wires without interfering with one another. In any telephone circuit of either aerial or short cable lines there is available for transmission services a range of frequencies extending from zero to 30,000 cycles per second. Various communication systems have been designed to enable the maximum use to be made of this range. In order to

demonstrate their possibilities two terminal equipments were set up in the lecture hall and several simultaneous communications over the same wires were carried on by telephone and telegraph without any interference.

It is well known that ordinary window glass cuts off the ultra-violet or "health-giving" rays. MR. F. E. LAMPLOUGH accordingly set himself to discover a glass which would permit the the passage of these rays. In his paper, "The Properties and Applications of 'Vita' Glass," he gave some account of this material, which, it is claimed, transmits radiation well below wave-lengths of 3,000. In the course of the paper a demonstration was given of spectrum photography to show the transmission of these waves through "vita" glass, and the results of certain experiments were also quoted to demonstrate the beneficial effects on animals reared under it.

MR. H. LYNTON FLETCHER, in his paper, "Recent Developments in educational Broadcasting," gave an account of what has been done by the B.B.C. to provide instruction for schools and for ordinary listeners. The regular daily transmission to schools was started in 1924, and by June, 1926, between 1,500 and 2,000 schools were on the register at London. By this time an efficient service had been organised; in many schools the pupils were regularly sending in written compositions or answers to problems, and terminal examinations had been instituted with excellent results. In the early stages there were numerous troubles to contend with. For instance, in many schools the reception was very bad and the difficulty of following the lessons naturally led to inattention in the classes. In some places the innovation was eyed with suspicion by the teachers, who feared that they might be supplanted by the wireless lessons. These and other difficulties and misconceptions have now been largely removed, and education by broadcasting is coming to be recognised as a supplementary but stimulating and valuable addition to the ordinary school curriculum.

Many people have considerable difficulty in understanding ordinary architectural plans and elevations, and even those who are accustomed to dealing with them every day do not always find that when they are executed in building materials the results are exactly what they intended. In his paper, "Building Models," MR. P. MORLEY HORDER urged the desirability of architects making models in addition to plans and elevations. Most clients can understand these readily, and many architects can learn a good deal from seeing what they propose to build in this form. It is not suggested that for ordinary purposes the models should be at all elaborate; they are made of the simplest and most inexpensive materials, so that they can easily be altered if any changes in the design are necessary, and when the building is completed they can be destroyed without much loss.

In illustrating his paper, "War and its Influence on the Arts," MR. CHARLES FFOULKES showed a large number of slides of military pictures, ranging from the Norman Conquest to the present day. In most of these the soldiers,

whether Israelites or Charlemagne's paladins, were equipped in the armour of the artist's day. From the eleventh to the sixteenth century the artist possessed no antiquarian knowledge, and his pictures are valueless as throwing light on anything but contemporary costume. Further, until recent times, there was always a tendency to depict troops on a battlefield as immaculately groomed as if they were on parade; it is only of late, and particularly in the work of those artists who painted scenes of the Great War, that sincere efforts have been made to portray war as it really is. Most of these came from the hands of painters who were at the front themselves, and shared the dangers of the fighting men, and their object was to paint the truth and not fancy pictures in which well-equipped troops with flying colours were always defeating a panic-stricken enemy.

The British Science Guild have recently published an important report on the British Patent system, and with a view to rousing public interest in the matter the Council invited Mr. ROBERT BURRELL to read a paper on "The Reform of the British Patent System." While expressing a very high opinion of the value of the report, Mr. Burrell drew attention to a number of points in which he thought the recommendations of the British Science Guild Committee could be improved. With regard to the question of extended search, for instance, he urged that the Treasury should cease to appropriate for other purposes monies paid by patentees as their contribution towards the cost of maintaining an efficient patent service, and he suggested the institution of a central international office for search purposes. The question of "novelty," admittedly an extremely difficult one, was also discussed, together with the extension of the protection of patent laws to inventions which are at present unpatentable, the reduction in the cost of patent litigation, and the means of reducing the existing congestion at the Patent Office and the introduction of facilities for securing a quicker patent grant than is at present possible.

II.—INDIAN SECTION.

Six papers were read at meetings of the Indian Section during the Session.

The important question of "Town Water Supply in India" was the subject of a paper by MR. J. W. MADELEY. Mr. Madeley, who had been responsible for the design, construction, and maintenance of the Madras Waterworks, gave a full account of the general conditions of Indian towns in the matter of water supply. The various problems connected with the provision of an adequate water service, such as the sources of supply, plant, filtration and pre-filtration treatment, were fully dealt with, and in conclusion the lecturer emphasised the importance of co-operation and of the education of public opinion in India to an appreciation of the fact that water must be husbanded, and that its waste or pollution is a crime against society.

A good deal of attention has been given of recent years to the position of the Indian sugar industry. Perhaps the most striking factor in the situation is that, whereas about 1840 India exported to Great Britain nearly 100,000 tons of sugar per annum, in 1926-27 she imported—mainly from Java—826,900 tons, her export trade having been practically extinguished by the competition of plantation sugar produced under European management and control in other parts of the world. In a paper on the subject, SIR JAMES MACKENNA reviewed the past and present position of the industry in relation both to tariffs and such matters as the breeding of improved canes, larger scale cultivation and the introduction of up-to-date methods of manufacture. Sir James submitted that the problem must be tackled from the agricultural and manufacturing side, and contributed a number of definite suggestions for the improvement of the industry.

In a paper on "The History of the Royal Indian Marine," CAPTAIN SIR EDWARD HEADLAM traced the history of the Indian Marine Service from its first inception in 1612 down to the present day. Through the three centuries of its existence the Indian Marine has undergone a number of changes both of title and establishment strength in accordance with successive changes of policy on the part of the British Government, but it can show through its long history a glorious record of almost continuous war service as well as of the performance of much important hydrographic survey work. In conclusion the lecturer expressed his assurance that the Royal Indian Marine whose main responsibility in the future would probably be the defence of the Indian seas, coasts and harbours, would worthily uphold the great traditions of its past history and maintain an honourable position among the Navies of the Empire.

MR. W. H. MORELAND's paper on "The Indian Peasant in History" was designed to provide an historical introduction or background to the recently published Report of the Commission on Indian Agriculture. After propounding the question why the Commission was required at all, and why it should be necessary to mobilise all the forces of India to inculcate a progressive spirit in her cultivators, Mr. Moreland expressed the view that the traditional apathy of the Indian peasant was due to the centuries-long oppression to which he had been subjected under Hindu and Moslem rule, rather than to any inherent defect of character. He was, however, showing distinct signs of recovering from the psychological effects of this regime, and there was now, he believed, "a reasonable hope that a concerted and sustained effort, such as the Report advises, may break up the crust once for all, may liberate the stores of energy which are now dormant, and may convince the peasants in the mass that it is worth their while to strive for the ideals they have never wholly lost."

In 1922 a paper dealing with the water power resources of India was read by Mr. J. W. Meares. A considerable amount of progress has been made since that date and a general survey of the present position in India in regard to the development and use of electrical energy was given by MR. A. T. COOPER in a paper entitled "Recent Electrical Progress in India." After referring to recent developments in telegraphy and telephony and to the supply of electricity in the principal cities of India and in the territories ruled by Indian Princes, Mr. Cooper described the salient features of the most recent hydro-electric schemes, *i.e.*, the Tata Power Company's scheme for the development of water power in the Western Ghats for transmission to Bombay City, the Punjab hydro-electric scheme for the utilisation of the snow-fed waters of the River Uhl in the hills above Simla to supply electricity to a number of towns in the Punjab and also for agricultural purposes, and the Pykara-Moyar project in the Nilgiri hills in the Madras Presidency. Mr. Cooper concluded his survey with some notes on the use of electricity for industrial purposes, for coal mining, railway traction, and broadcasting.

The subject of the Sir George Birdwood Memorial Lecture, delivered by CAPTAIN P. JOHNSTON-SAINT, was "An Outline of the History of Medicine in India." After remarking upon the general ignorance which has existed in Europe for the past 200 years in regard to Indian Medicine, the lecturer referred to Dhanwantari, its mythological founder, and to the beginnings of authentic medical history associated with the names of Susruta and Charaka, the fathers respectively of Indian Surgery and Medicine, and proceeded to give an account in some detail of ancient Indian practice, which revealed some striking anticipations of modern knowledge. Captain Johnston-Saint emphasised the importance of the Indian contribution to Medical Science and expressed the hope that the research work now being carried out at various centres in India would result in the restoration of India to her rightful position as the birthplace of the medicine of the world.

III.—DOMINIONS AND COLONIES SECTION.

Four papers were read before the Dominions and Colonies Section during the Session.

The Society of Arts offered premiums and medals for maps of the counties of England as far back as 1759, and continued to do so until the beginning of the 19th century. It was, therefore, quite fitting that a paper on "Air Survey and Empire Development," by COLONEL H. L. CROTHWAIT should be devoted to the new art of Air Survey. After emphasising the cardinal importance of correctly mapping new and little-known territories before undertaking their economic development, Col. Crothwait proceeded to explain how an air survey is carried out, and the suitability of this method for such engineering projects as the investigation of the alignment for new railways and of sites for water-power development and water-storage schemes.

He also emphasised the fact that valuable information as to geological structure, mineralization, soil conditions, etc., is afforded by air survey.

In a paper on "The Improvement of Negro Agriculture," LORD OLIVIER showed that negro agriculture is not the irrational, "higgledy-piggledy" affair which it appears to be to the superficial European observer, but is based on a considerable amount of experience and knowledge. Native methods are, however, only suited to countries where there is a more or less unlimited supply of land, and are extremely wasteful and uneconomic when applied to land intended for permanent occupation. The lecturer laid stress on the extreme care and tact required in educating the native to improved methods of cultivation, and gave an interesting account of the operations of the Jamaica Agricultural Society, which has done a great deal of successful work in raising the standard of native agriculture in that colony.

In view of the meeting of the British Association for the Advancement of Science which is being held at Cape Town in August, it was decided to include in the programme of the Dominions and Colonies Section two papers dealing with South African mineral development. In a paper on "The South African Iron and Steel Industry" DR. H. J. VAN DER BYL outlined the previous attempts which have been made to establish an iron and steel industry in South Africa, and gave an interesting account of the recent formation, with the support and participation of the South African Government, of the South African Iron and Steel Corporation. The Corporation has been established by Act of Parliament, and its constitution is drawn on similar lines to that of the Electricity Supply Commission which was established by the South African Government in 1923, and has been highly successful, having grown in six years into one of the largest electric supply undertakings in the Empire. Dr. van der Byl described in detail the constitution of the Corporation, the main feature of which is that, after the payment of dividends of 6 per cent. on the Government shares and of 12½ per cent. on shares held by the public, surplus profits are to be devoted to the reduction of the price of iron and steel products, and also dealt with the technical aspects and commercial possibilities of the enterprise.

In a paper on "The Base Metal and Mineral Resources of South Africa," MR. H. WARINGTON SMYTH gave a review of the present position of the base metal and mineral industries of South Africa, including coal, copper, tin, lead, chrome, asbestos, soda, and a number of other metals and minerals. Mr. Warington Smyth illustrated his paper by the production figures of recent years and described the special conditions of South African mining. In conclusion he expressed the view that, generally speaking, the base mineral production of South Africa is capable of indefinite expansion provided that measures are taken to ensure regularity, careful grading, and uniform quality of output.

IV.—DR. MANN JUVENILE LECTURES.

Under the Dr. Mann Trust two Juvenile Lectures were delivered by CAPTAIN SIR ARTHUR CLARKE on "Ships and Lighthouses." In the first was told the story of the ship and the sailor from the time of Noah's Ark to the present day. The tale was woven round the various styles of ships, which succeeded one another down the centuries, and the sailors who fought and traded in them—the coracle of the ancient Britons, the Roman galley, the ships of the Norsemen, the Saxon ships of King Alfred, the galleons of the 16th century, the ships of Blake and Van Tromp, the ships of the line and frigates of the 18th century, the clippers like the *Cutty Sark*, and the modern leviathans such as the *Mauretania* and the *Royal Oak*.

The second lecture dealt with lighthouses, "the street lamps of the sea." Beginning with the famous Pharos of Alexandria, one of the seven wonders of the ancient world, Sir Arthur described and illustrated the historical development of methods of illumination used in lighthouses—beacon fires of wood and coal, candles, paraffin lanterns, incandescent petroleum, and electric light. He also referred to the numerous modern devices for securing the automatic operation of the lights, and concluded with some remarks on directional wireless, which might be destined to become the most important of all agencies for the protection of life and property at sea.

V.—CANTOR LECTURES.

The first course of lectures under the Cantor Trust was delivered by DR. FRANKLIN KIDD on the subject of "Biology and Refrigeration." He pointed out that the preservation of food by cold is a biological problem. The living organism is controlled by environment. The relations between temperature and the rate and character of change in animals and plants were considered and some description was given of the effects of low temperature upon plants and plant produce. In the second lecture more detailed study was made of the apple as a type fruit. In preserving these account must be taken both of pre-storage factors, such as race and nutrition, and storage factors, such as temperature, humidity, atmospheric composition, etc. The third lecture dealt with the phenomena arising from the freezing of tissues, the effects depending on the rate of cooling and thawing, and on the condition of tissues, and the changes occurring at temperatures below the freezing point of water.

The unprecedented depression which has overhung the coal industry for the last four or five years has added importance to any steps towards a more scientific use of coal. Special interest was therefore taken in the second course of Cantor Lectures by DR. C. H. LANDER on "The Treatment of Coal." In the first lecture he discussed the use of coal in its raw state, especially with regard to steam raising, pulverised fuel, furnaces and process work and the production of heat for domestic purposes. The second lecture was devoted

to high temperature carbonisation processes and coke treatment, while the third dealt with low temperature carbonisation, and summed up the latest developments in connexion with hydrogenation and synthetic processes, and the combustion of oil.

VI.—SHAW LECTURES.

A series of three lectures under the Shaw Trust was given by SIR THOMAS MORRISON LEGGE on "Thirty Years' Experience of Industrial Maladies." After emphasising the importance of "looks" as supplying valuable information in regard to the effects of factory life upon the health and well-being of the workers, the lecturer reviewed the results obtained by the notification of diseases—extinction or diminution in the case of certain diseases, and a stationary condition in others. Finally, he dealt with the question of compensation and the twenty-eight forms of industrial disease which have been scheduled under the Compensation Act, and illustrated the results obtained by means of a chart.

VII.—ALDRED LECTURES.

A considerable amount of progress has been made during recent years in our knowledge of the obscure causes and circumstances of those nomadic movements which took their rise in Asia during the dark and middle ages and threatened more than once to engulf Europe. Since the time of the historian Gibbon a number of Chinese and Persian records, which were not accessible in his day, have become available to European scholars, and in a series of four lectures on "Nomadic Movements in Asia," given under the Aldred Trust, SIR E. DENISON ROSS, who made full use of the latest sources of information, dealt in general outline with the four great nomadic movements which took place from the seventh to the thirteenth century.

VIII.—ALBERT MEDAL.

The Albert Medal of the Society for the current year has been awarded by the Council, with the approval of the President, H.R.H. the Duke of Connaught, to Principal Sir (James) Alfred Ewing, K.C.B., LL.D., F.R.S., "for his work in magnetism and his services to technical education."

Sir Alfred Ewing was Professor of Mechanism and Applied Mechanics in the University of Cambridge from 1890-1903; Director of Naval Education from 1903-16; and Principal and Vice-Chancellor of the University of Edinburgh from 1916 to the present date. He is the author of various books and articles in the *Encyclopædia Britannica* on the thermo-dynamics of the steam engine and of the refrigerator, while at the same time he has written important original papers on magnetism, including what is known as the hysteresis of iron.

IX.—MEDALS FOR PAPERS.

Eleven silver medals have been awarded for papers read before the Society during the current session—seven for papers read at Ordinary Meetings, two for papers read before the Indian Section, and two for those read before the Dominions and Colonies Section.

The awards are as follows :—

Papers read at the Ordinary Meetings :—

Sir Eustace Tennyson d'Eyncourt, K.C.B., D.Sc., LL.D., F.R.S., " Fuel for Ships "

G. G. Blake, M.I.E.E., F.Inst.P., " Applications of Electricity to Medical Practice."

Cecil Hooper, F.L.S., " Fruit Pollination in Relation to Commercial Fruit Growing."

JAMES MORTON, " History of the Development of Fast Dyeing and Dyes."

Professor A. E. Richardson, F.R.I.B.A., " Modern English Architecture."

G. H. Nash, C.B.E., M.I.E.E. (European Chief Engineer, International Standard Electric Corporation), " Some Modern Aspects of Electrical Communication."

Robert Burrell, Barrister-at-Law, " Reform of the British Patent System."

Papers read before the Indian Section :—

W. H. Moreland C.S.I., C.I.E., " The Indian Peasant in History: an Introduction to the Linlithgow Report."

A. T. Cooper, M.Inst.C.E., M. Cons. E., " Recent Electrical Progress in India."

Papers read before the Dominions and Colonies Section :—

Colonel H. L. Crosthwait, C.I.E., " Air Survey and Empire Development."

Dr. H. J. Van der Byl, " The South African Iron and Steel Industry."

For many years it has been the practice not to award medals either to members of the Council or to persons who have already received a medal for a paper read in a previous year. The Council were therefore precluded from considering the following papers :—

Omar Ramsden, R.M.S., " English Silver and its Future."

Professor Edward Percy Stebbing, M.A., F.L.S., " Forestry in Sweden: Its Importance to and Influence on Great Britain."

Professor Charles R. Darling, A.R.C.Sc.I., F.I.C., " The Domestic Smoke Problem - a Practical Solution."

Sir Henry A. Miers, F.R.S., " Museums and Education."

George Fletcher, " The Shannon Scheme and its Economic Consequences."

P. Morley Horder, F.S.A., " Architectural Models."

Sir James MacKenna, C.I.E., " The Sugar Industry of India."

The Right Hon. Lord Olivier, P.C., K.C.M.G., C.B., LL.D., "The Improvement of Negro Agriculture."

The Council, however, desire to express their high appreciation of these papers.

X.—FUND FOR THE PRESERVATION OF ANCIENT COTTAGES.

This fund was inaugurated at a conference held in January, 1927, which was presided over by the Prime Minister, the Rt. Hon. Stanley Baldwin, who afterwards issued an appeal in support of it. The first general meeting of the subscribers was held on February 27th, 1929; the chair was taken by the Rt. Hon. J. Ramsay MacDonald, and he was supported by Mr. G. K. Chesterton, Sir Charles Wakefield, Mr. H. Avray Tipping, Sir Arnold Wilson, Sir Fabian Ware, and Sir George Sutton*. The first annual report, which was adopted on the motion of Mr. Ramsay MacDonald, gave an account of the work which had been so far accomplished. The Society has become the owner of Charles Lamb's Cottage, "Buttonsnap," West Mill Green, Hertfordshire, which was handed over to it by Mrs. T. T. Greg. It was mainly instrumental in saving the three beautiful Thomas a Becket cottages, near Worthing, and it has purchased and is now engaged in re-conditioning the group of cottages known as Arlington Row, in the beautiful village of Bibury, Gloucestershire. Thanks largely to the zeal and inspiration of Mr. P. Morley Horder, the Chairman of the Executive Committee of the Fund, over thirty half-timbered cottages near Shrewsbury, which in the ordinary way would have been condemned, have been saved and re-conditioned, and the general attitude of the Shrewsbury District Council is very encouraging. Various other cases in different parts of the country have been considered and assisted by the Committee.

In the annual report it was stated that the Committee were considering the possibility of securing a complete village. Shortly after its publication the village of West Wycombe came into the market. It is an excellent example of an old English rural community, and includes about fifty dwellings dating from Tudor to Georgian times, and two inns. The place depends for its livelihood mainly on the historic industry of chairmaking, and contains two factories. A feature of the street is the beautiful old "Church Loft," which dates from the fifteenth century and is in excellent preservation.

The owner of the village, Sir John Dashwood, appreciating the advantages of having at his gates a village controlled by a body with a reputation such as that of the Royal Society of Arts, agreed to sell the whole at the moderate figure of £13,500. Of this sum, £3,375 has now been paid, the remainder being left on mortgage. It is not yet possible to estimate definitely the cost of the repairs, but the Committee think it advisable to aim at a sum of £20,000.

*A full report of the meeting and of the First Annual Report was published in the Journal of March 15th, 1929.

An illustrated appeal is being prepared, and it is hoped that it will meet with a generous response.

With regard to finance, about £7,750 has now been received in subscriptions to the general fund (apart from some £1,200 subscribed to the special fund for the preservation of Arlington Row, Bibury). Of this sum, £2,025 has been contributed by Mr. James H. Hyde, for whose generous help the Council desire to express their warmest thanks. While the possession of this sum in hand enabled the Society to settle the purchase of West Wycombe at very short notice, the Council are anxious that it should not be finally depleted, and they therefore appeal to all who love the English countryside, and especially to the inhabitants of Buckinghamshire to subscribe the amount needed for the purchase and re-conditioning of West Wycombe, so that the general fund may be available for further preservation work.

It should be pointed out that the Society has placed its offices and staff at the service of the Fund for the Preservation of Ancient Cottages, without any charge, and thus the Fund has been entirely free from rent and secretarial salaries. Apart from a small sum for printing, postage and extra clerical help, there have thus been no overhead charges, and subscribers have the satisfaction of knowing that practically every penny of the money they subscribe goes directly to the purchase and repairing of cottages.

XI.—THOMAS GRAY MEMORIAL TRUST.

Under the Thomas Gray Memorial Trust, the objects of which are "the advancement of the science of navigation and the scientific and educational interests of the British Mercantile Marine," the Council have offered the following prizes :—

(i) A Prize of £150 to any person who may bring to their notice a valuable improvement in the Science or Practice of Navigation proposed or invented by himself in the years 1928 and 1929.

In the event of more than one such improvement being approved, the Council reserve the right of dividing the amount into two or more prizes at their discretion.

Competitors must forward their proofs of claim on or before December 31st, 1929.

(ii) A Prize of £50 for an essay on the following subject :—

"You are overtaken by a revolving storm. Discuss the handling of a low-powered steamer from the time of the first indication of the approach of the storm until the storm has passed, supposing the ship to be in (a) the safe semicircle, (b) the dangerous semicircle, and (c) the direct path of the storm's centre."

Competitors must send in their essays not later than December 31st, 1929, to the Secretary, Royal Society of Arts, at the above address.

Similar prizes were offered last year. The judges were of opinion that none of the inventions submitted was of sufficient value to justify the full award, but on their recommendation the Council awarded prizes as follows :—

A Prize of £30 to Lieut. Donald MacMillan, R.N.R., for his "Navigator's Ex-Meridian Diagram," and

A Prize of £20 to Captain John Barrance Browning for his "Browning Star Plotter."

For the prize of £50 eighteen essays were submitted and in accordance with the unanimous recommendation of the judges, the Council has awarded it to Mr. P. S. Atkins, Second Officer, T.S.S. *Sarpedon*, Blue Funnel Line.

The Council have again offered the following prizes to the best students of Navigation in the schools mentioned below for the year 1928-9:--

Three prizes of £10 each to the Nautical College, Pangbourne; *Conway*, Birkenhead; *Worcester*, Greenhithe.

Four prizes of £5 each to *Arethusa*, London; *Warspite*, London; *Indefatigable*, London; *Mercury*, Southampton

In order to stimulate further the study of navigation, the Council last year offered a Thomas Gray Memorial Prize of £30 to be competed for by the best students of the Nautical College, Pangbourne, the *Conway* and the *Worcester*.

The prize was awarded to Cadet-Captain John Herbert Chalk, of the Nautical College, Pangbourne, and Honourable Mention was accorded to P. Beeham (T.S. *Worcester*), C. D. Callieu (T.S. *Worcester*) and H. G. Tracey (Nautical College, Pangbourne). The prize was presented at the Nautical College, Pangbourne, in July last, by Captain Sir Arthur Clarke, K.B.E., Chairman of the Thomas Gray Memorial Trust Committee.

As soon as the fund permits, a scholarship of £25 per annum, to be held for two or three years, will be offered in rotation to the above mentioned three training schools.

XII.—ANNUAL COMPETITION OF INDUSTRIAL DESIGNS.

The sixth Annual Competition of Industrial Designs will be held at the Imperial Institute in July, by kind permission of the Director.

The competition is again being held in the following sections:—(1) Architectural Decoration; (2) Textiles; (3) Furniture; (4) Book Production; (5) Pottery and Glass; and (6) Advertising (Posters, Show-cards, etc.). The total value of the prizes offered in all the sections amounts to over £2,000. A number of well-known firms have again offered very substantial prizes for designs in various sections.

It has always been the aim of the Council and of the various committees appointed by them to carry out this competition to ensure that any designs approved by them should bear evidence that the designers possess not only exceptional artistic ability, but also a sound and practical knowledge of the materials and processes of their trades. The committees consist mainly of representatives of important manufacturing and commercial firms, and the judges nominated by them are careful to see that approved designs are suitable for the materials for which they are intended.

After the awards have been made, a number of selected designs will be exhibited at the Imperial Institute; probably also exhibitions will be held at suitable centres outside London, where the designs will be brought to the notice of manufacturers likely to be specially interested in them.

As soon as the judges have completed their work, it is proposed to issue, as formerly, a full report on the Competition, which will be published in the *Journal*, and circulated widely among manufacturers and competitors.

The Council have opened a Bureau of Information at which are kept the names and addresses of those candidates at the Annual Competition of Industrial Designs whose work has been accepted for exhibition and who desire to obtain employment as designers. Although no guarantee of employment can be given, the information is placed at the service of manufacturers in search of designers. A number of appointments have been made in this way, and a good many designs have been sold at the exhibitions.

XIII. -EXAMINATIONS.

The Society's examinations are now held regularly at Easter, Whitsuntide and in July, while special sets of group examinations are conducted, at the request of the London County Council, for L.C.C. Junior Commercial and Junior Technical Institutes, and a further set of examinations is held for students at Day Schools. The total number of entries this year is 105,676, an increase of about 5,000, as compared with the total for last year. A full report on the Examinations will, as usual, be published in the *Journal* at a later date.

The liberality of the Worshipful Company of Clothworkers has enabled the Council, as in past years, to offer the usual silver and bronze medals. These medals are greatly valued by the successful candidates, and they contribute not a little to maintain the high standard of the examinations.

XIV.—ORAL EXAMINATIONS IN MODERN LANGUAGES.

The Oral Examinations are still in progress in various parts of the country. Particulars will be given in the annual report on the Examinations.

XV.—NEW COUNCIL.

The Vice-Presidents retiring under the ordinary regulations are: Sir Charles Stuart Bayley, Sir John Cadman, Sir Alexander Gibb, Sir Francis G. Ogilvie, and Professor John Millar Thomson. In their places the Council recommend Sir Otto Beit, Sir George Marjoribanks, Sir Charles Wakefield (none of whom have served on the Council in any capacity during the current year), Captain Sir Arthur Clarke and Sir Reginald A. Mant.

The Ordinary Members of Council retiring under the regulations are: the Rt. Hon. George N. Barnes, Captain Sir Arthur Clarke, Sir Reginald Mant and Mr. W. J. U. Woolcock. In their places the Council recommend Mr.

Alfred Carpmael, Sir David T. Chadwick, Col. Sir Henry McMahon and Mr. John A. Milne, none of whom have served on the Council in any capacity during the current year.

XVI.—OBITUARY.

The Society has lost a number of distinguished Fellows during the year.

Lord Rosebery was a Fellow of the Society for fifty-three years, and served for two periods as a Vice-President and Member of the Council.

Sir Henry Trueman Wood was Secretary of the Society for thirty-eight years. On his retirement in 1917 he was elected a member of the Council, and served as Chairman in 1919-20. In recognition of his services to the Society he was nominated a Vice-President by H.R.H. the President.

Sir Charles Herbert Theophilus Metcalfe was a well-known engineer, who was responsible for carrying out much important railway work in Africa. He was a Fellow of the Society for nearly 40 years, and was a valuable member of the Dominions and Colonies Section.

Sir Charles Macara was for many years a leading figure in the cotton industry.

H.H. Prince John of Liechtenstein, was elected a Life Fellow of the Society in 1892.

Alderman Cedric Chivers, who died during his sixth year of office as Mayor of Bath, had established an international reputation as a book-binder, and had a factory in Brooklyn as well as in Bath.

Mr. Thomas Brough was chief designer to Messrs. Courtaulds, Ltd. He recently read a paper on "Artificial Silk," for which he received the Society's Silver Medal.

Mr. Thomas Holmes Blakesley, in addition to being a distinguished engineer, conducted a number of important researches in physical science, especially optics and electricity. At the time of his death he had been a Fellow of the Society for exactly fifty years.

Mr. C. W. Darley, after carrying out a great deal of work in connexion with railways, harbours and water supply in New South Wales, was appointed consulting engineer in London to the N.S.W. Government.

Mr. Trevor B. Simon, a well-known mining engineer of Pittsburgh, U.S.A., was president of the C.L. Miller Company, and rendered valuable service during the war in the United State Army Ordnance Department.

Obituary notices of these and some other Fellows have appeared in the columns of the *Journal*.

XVII. FINANCE.

The Financial Statement for 1928, published in accordance with Section 25 of the Society's Bye-Laws in the *Journal* of June 21st, shows that the excess of expenditure over income for the year was £463 7s. The item, "Superannuation Fund . . . £524 8s." appears for the first time in this statement.

The Society's House was purchased in 1922. The price paid was £42,000 ; alterations, repairs, furniture, architects' fees, legal expenses, interest on overdraft, etc., amounted to £8,392 16s. 7d., making a total of £50,392 16s. 7d. Towards this £43,506 13s. 2d. has been received in donations from Fellows of the Society and others, leaving a deficit of £6,886 3s. 5d.

For the years since the House was purchased the annual Financial Statements have shown surpluses or deficits as follows :—

			<i>Surplus.</i>			<i>Deficit.</i>		
			£	s.	d.	£	s.	d.
1922	...	...	596	17	4			
1923	...	...	1,383	13	8			
1924	...	...	974	4	7			
1925	...	...	154	16	3			
1926	...	...	828	15	9			
1927	...	...				570	5	8
1928	...	...				463	7	0
			£3,938	7	7	£1,033	12	8

The total difference between the surpluses and deficits for these years is £2,904 14s. 11d. which has been placed to the credit of the Premises Account. When this is deducted there is still a deficit of £3,981 8s. 6d. The Council are extremely anxious that this amount should be raised, and they appeal once more to the Fellows to contribute to the Building Fund in order that they may carry on the work of the Society unhampered by financial anxieties.

THE CHAIRMAN, in moving the adoption of the Report, said that the outstanding new matter in the Report was the Preservation of Ancient Cottages, in connexion with which the Council had been very busy during the year. Another matter that was new was the question of pensions for the Officers of the Society. The Society was very largely indebted to Sir Thomas Holland for seeing that matter through during his Chairmanship of the Council. He would take this opportunity of saying how glad the Council was to know that Sir Thomas had been appointed to the high office of Principal and Vice-Chancellor of the University of Edinburgh.

LORD ASKWITH, K.C.B., K.C., D.C.L., in seconding the adoption of the Report, said that mention was made in the Report that the Society had placed its offices and staff at the service of the Fund for the Preservation of Ancient Cottages, without any charge, and thus the Fund had been entirely free from rent and secretarial salaries. This was a great assistance rendered by the Society for the Fund.

The Report was unanimously adopted.

The new List of Council, having been suspended in the Library in accordance with the Bye-Laws, and no additional nominations having been made, the CHAIRMAN declared that the following were elected to fill the several offices. (The names in italics are of those Fellows who have not, during the past year, filled the office to which they have been elected) :—

PRESIDENT.

H.R.H. The Duke of Connaught and Strathearn, K.G.

VICE-PRESIDENTS.

- *Lord Askwith, K.C.B., K.C., D.C.L.
- Llewelyn B. Atkinson, M.I.E.E.
- Sir Otto Best*, K.C.M.G.
- Lord Bledisloe, P.C., K.B.E.
- Captain Sir Arthur Clarke*, K.B.E.
- *Sir Dugald Clerk, K.B.E., D.Sc., F.R.S.
- Sir William Henry Davison, K.B.E., D.L., M.P.
- Peter MacIntyre Evans, M.A., LL.D.
- Sir Edward Gait, K.C.S.I., C.I.E.
- Sir Robert Abbott Hadfield, Bt., D.Sc., F.R.S.
- Rear-Admiral James de Courcy Hamilton, M.V.O.
- John S. Highfield, M.Inst.C.E., M.I.E.E.
- Sir Thomas Holland, K.C.S.I., K.C.I.E., D.Sc., F.R.S.
- P. Morley Horder, F.S.A.
- Sir Herbert Jackson, K.B.E., F.R.S.
- Major Sir Humphrey Leggett, D.S.O., R.E.
- Sir Philip Magnus, Bt.
- Sir Reginald A. Mant*, K.C.I.E., C.S.I.
- Sir George Marjoribanks*, K.C.V.O.
- *Hon. Sir Charles A. Parsons, O.M., K.C.B., LL.D., D.Sc., F.R.S.
- *Alan A. Campbell Swinton, F.R.S.
- Sir Charles C. Wakefield*, Bt., C.M.G.
- Sir Frank Warner, K.B.E.
- Sir Alfred Yarrow, Bt., F.R.S.

ORDINARY MEMBERS OF

- Alfred Carpmael*
- Sir D. T. Chadwick*, C.S.I., C.I.E.
- Sir Atul C. Chatterjee, C.I.E.
- Col. Sir Arthur Holbrook, K.B.E., M.P.
- Col. Sir Henry McMahon*, G.C.M.G., G.C.V.O.
- Sir Henry A. Miers, F.R.S.
- John A. Milne*, C.B.E.
- Sir Richard Redmayne, K.C.B.
- Col. The Master of Sempill
- James Swinburne, F.R.S.

*Nominated by H.R.H. the President.

Carmichael Thomas.

Lt.-Col. Sir Arnold T. Wilson, K.C.I.E., C.S.I., C.M.G., D.S.O.

TREASURERS.

Sir Charles H. Armstrong.

Sir George Sutton, Bt.

THE CHAIRMAN then proposed a cordial vote of thanks to Mr. G. K. Menzies (the Secretary), Mr. W. Perry (the Assistant-Secretary and Secretary of the Indian and Dominions and Colonies Sections), Mr. J. H. Buchanan (the Accountant and Examinations Officer), Mr. C. D. Cassidy (the Librarian), Mr. H. J. Dack (the Chief Clerk), and to the other Officers of the Society, for their services during the year.

The motion was duly seconded, and the vote of thanks carried unanimously.

THE SECRETARY said that he felt sure that the Society would like to record their thanks to the Honorary Solicitors of the Society, Messrs. Bristows, Cooke and Carpmac. They became Honorary Solicitors to the Society about two years ago, and since then had done an enormous amount of work, especially in connexion with the Preservation of West Wycombe. The Society would certainly have incurred heavy legal expenses, both in that and the matter of Arlington Row, Bibury, without the help of the Honorary Solicitors.

THE CHAIRMAN thereupon proposed a vote of thanks to the Honorary Solicitors and the motion was carried unanimously.

SIR THOMAS HOLLAND, K.C.S.I., K.C.I.E., D.Sc., F.R.S., in proposing a vote of thanks to the Chairman, said that Sir George Sutton had not, he thought, missed a meeting and had presided in his official capacity not only at the Council, but at many of the Committees, and especially the Examinations Committee, which had done so much valuable work for the Society. It had already been mentioned that the examination entries had now touched 105,000 as the total for the year. That figure was a record for the Society, and it probably put us in the uncomfortable position of being the largest examining body in the world. Sir George Sutton had been very active as the Deputy Chairman of the Committee. It was even more gratifying to the Council, as they regarded him as one of the products of their Examinations. Very many years ago he passed his first examination at the Royal Society of Arts, and the Council hoped that Sir George's example would serve as a stimulus for all young students.

The motion having been duly seconded, the vote of thanks was carried unanimously.

THE CHAIRMAN, in acknowledging the vote of thanks, thanked Sir Thomas Holland for the kind remarks he had made. The year's work had been exceedingly pleasant, and he had never had anything to do in an honorary way which had given him more pleasure than presiding at the meetings of the Council of the Royal Society of Arts. The business had been interesting, but there had been a good deal of it. As this would be the last meeting he would attend as Chairman, he would like to emphasise that a Society like this, that had to depend on men who were very active in the world, must be very careful that it did not take upon itself too much work so that people would fight shy if asked to serve. This was a scientific Society, promoted for the encouragement of Arts, Manufactures and Commerce, and had existed for a century and three quarters, and to keep the Society strong and let it live for another century and three quarters it wanted good men to take an interest in the work. The members of the Council were giving the time now, and he admired the splendid meetings of the Council which had taken place during the past year. The Council Room had been crowded out month after month, which was a great tribute to the zeal with which members of the Council discharged their task. Some of them gave a great deal of attention to the work of the Society. In particular, Mr. Morley Horder, Chairman of the Fund for the Preservation of Ancient Cottages, had shown the greatest enthusiasm and had devoted much time and professional assistance to the cause.

NOTES ON BOOKS.

DOMESTIC ARCHITECTURE AND OLD FURNITURE. By Murray Adams-Acton, F.S.A. London: Geoffrey Bles. £2 2s. net.

This sumptuous and agreeable book, with its wealth of illustrations, celebrates the living past. As the author reminds us in his preface not in these words - all old things are not in museums. Whole towns are standing, built in the distant past, that are inhabited, full of animation, practically untouched by the architects of the twentieth century. There is Bath, there is Bamberg, there is a host of delicious little provincial centres in Europe as well as a few at home where the atmosphere of more restful ages can be recaptured and enjoyed. The happy man of leisure and taste can take his choice: Bavaria alone offers him the middle ages and the eighteenth century, and a chain of Baroque cities stretches across Europe from Trier to Cracow. I am told that Vicenza is a coherent and organic whole, and one gathers from Mr. Adams-Acton that Verneuil is off the arterial highway of modern progress. And it is not only the houses that are intact: so are their frescoes, and so, very often, is their furniture. The framework of the ancient world has not yet been destroyed; barons and squires still live in the castles and manors and among the heirlooms of their ancestors.

The nineteenth century, from the artistic point of view so relatively barren, and the twentieth century, still so young and raw, offer little material for study by the lover of beautiful things compared with what earlier times can show. There is, Mr. Adams-Acton tells us, a considerable vogue in America for early Victorian furniture, but what is it beside the vogue for Chippendale or Louis Quinze?

HANDCRAFT IN WOOD AND METAL. By J. Hooper and A. J. Shirley. London : B. T. Batsford, Ltd. 10s. 6d. net.

The handicrafts are not as moribund in England as may be feared. A recent series of articles in the *Times*, describing various local industries of the craft order, drew attention to what is being done in the different counties. The two blacksmiths in my village are ironworkers of no little skill. They turn out excellent hinges, fire-irons and candle brackets. So, it appears, do the forges in other parts of Kent. To my knowledge, also, a neighbouring carpenter has carried out some designs for corner cupboards and other furniture with a good deal of taste. He is certainly not an isolated case.

Messrs. Hooper and Shirley's text book, here in its third edition, is perhaps more utilitarian than inspiring. That is, we may be taught by it to use our tools correctly, but we shall be a little alarmed by the sad results which may be achieved by a punctilious observance of the rules laid down for our guidance. Take the frontispiece. It would be most disagreeable to have to spend even a few hours in a house ornamented with such skilful and vapid samples of the craftsman's art. The platter is not offensive, but the inlaid mirror has no æsthetic value whatever and the candlestick is vulgar. England is now strewn with tea-houses where this type of craftwork can be studied *ad nauseam*.

It is too easily assumed that somehow or other "art" will tread inevitably on the heels of "craft," as "love" is said to come with time into marriages of convenience. Art is actually more shy of ingenuity than of anything. Ingenuity has a way of posing as an end in itself, and for ingenuity, for the "gadget", our age has a passion. Describing a station restaurant, Roger Fry wrote: "In the centre of each table is a large pot in which every beautiful quality in the material and making of pots has been carefully obliterated by methods each of which implies profound scientific knowledge and great inventive talent." It does not need machinery to produce these devastating effects. Handcraft unilluminated by taste is every whit as bad. It is a question, too, whether no taste at all or bad taste is the worse. We can sometimes put up cheerfully with a medley of decorations, good and bad; but a room complete from end to end with calculated minor horrors—no.

Still it is only by trying that we can hope to bring about a *rapprochement* between art and necessity. Our misfortune is our forebears allowed an estrangement to come about. To-day craftsmanship savours of the "hobby" and suggests feeble amateurishness. It seems incredible that the greatest race of artists the world has known came out of the booths of craftsmen, yet was it so. This recollection may hearten the student depressed by the weakness of the models held up to him.

Messrs. Hooper and Shirley have done their best to direct their readers to models capable of inspiring. There have been craftsmen of talent from remote antiquity, and we may be sure that as often as not the atmosphere in which they worked was not specially friendly to refinements of art, there were philistines before the accession of Victoria. Set against the frontispiece the magnificent doorway by the brothers Adam, of which there is a photograph on page 110. Here the separate parts are beautiful, most beautiful in their subordination to whole. The "purpose" for which they are "fitted" is an æsthetic one; the portico would have been no less secure against the elements if a bad craftsman had been let loose on it.

A good deal may be learnt from "Handcraft in Wood and Metal," but its influence would be better if its space and its praise were less indiscriminately apportioned between experimental stuff and masterpieces.

P.B.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 3999.

VOL. LXXVII.

FRIDAY, JULY 12th, 1929.

All communications to the Society should be addressed to the Secretary, John Street, Adelphi, W.C. 2.

NOTICE.

PRESENTATION OF THE SOCIETY'S ALBERT MEDAL TO SIR ALFRED EWING.

The Council of the Royal Society of Arts attended at Clarence House on July 2nd, when H.R.H. the Duke of Connaught, K.G., President of the Society, presented the Albert Medal for 1929 to Principal Sir J. Alfred Ewing, K.C.B., LL.D., D.Sc., F.R.S., "for his work in magnetism and his services to technical education." Lt.-Col. G. C. Douglas Gordon, C.V.O., D.S.O., was in attendance upon His Royal Highness.

The members of the Council present were: Sir George Sutton, Bt. (Chairman); Mr. Evelyn B. Atkinson; Sir David Chadwick, C.S.I., C.I.E.; Mr. P. M. Evans; Sir Edward Gait, K.C.S.I., C.I.E.; Sir Thomas H. Holland, K.C.S.I., K.C.I.E., F.R.S.; Major Sir Humphrey Leggett, D.S.O.; Sir Philip Magnus, Bt.; Professor John Millar Thomson, F.R.S.; Mr. J. A. Milne, C.B.E.; Sir Richard Redmayne, K.C.B.; Mr. Carmichael Thomas, and Lt.-Col. Sir Arnold F. Wilson, K.C.I.E., C.S.I., D.S.O., with Mr. G. K. Menzies (Secretary) and Mr. W. Perry (Assistant Secretary).

PROCEEDINGS OF THE SOCIETY

INDIAN SECTION.

SIR GEORGE BIRDWOOD MEMORIAL LECTURE.

FRIDAY, MAY 10th, 1929.

SIR E. DENISON ROSS, C.I.E., Ph.D., in the Chair.

THE CHAIRMAN, in introducing the lecturer, said Captain Johnston-Saint was not a doctor. He had, however, spent six years in India, and was first and foremost a historian. For many years he had been connected with the wonderful Wellcome Historical Museum of Medicine, and had had opportunities of making investigations into the resources and history of medical practice and medical instruments, not only in England but on the Continent and in the East.

The following lecture was then delivered:—

AN OUTLINE OF THE HISTORY OF MEDICINE IN INDIA

By CAPTAIN P. JOHNSTON-SAINT, M.A. (Cantab), F.R.S. (Edin.), I.A. (ret'd.),
of the Wellcome Historical Medical Museum.

In the year 1645, Dr. Gabriel Boughton, who was surgeon of the *Hopewell*, successfully treated several members of the household of the Emperor Shah Jehan, and in the following year he also treated the Governor of Bengal. For these services Boughton was asked to name his own reward, but he replied that he wished for nothing except that his countrymen might be granted a maritime settlement in Bengal. Shah Jehan granted him a firman which enabled a factory to be opened at Hugli and a settlement at Balasore. The latter was fortified and consequently became the key of the position which the British have since acquired.

We observe then that this foundation stone of British power in India was laid, not by fire and the sword, but by that bond of sympathy and understanding which is associated with medicine wherever it is practised.

In those days of course, and for long after, we Europeans held in the lowest esteem every pretension of the East to any real knowledge at all. The many and varied races of immemorial India we thought fit to lump together as "barbarians," and our earliest doctors to go out there wrote, when they wrote at all, of Indian medicine as a matter of childish charms and philtres, almost a sort of Voodoo devil dancing.¹

A few inexplicable tricks the natives might have, but in the main their arts were but superstitious nonsense as compared to the blazing light of Western science.

Of the point of view of the Indian doctor faced by this foreign superiority we need now say little; it may suffice to notice that for generations after the first European invasion a malady became known to the Hindu doctor as "Portuguese Disease."² It was the contribution of Western enlightenment to the darkness of the benighted East.

EARLY WESTERN IGNORANCE OF INDIAN HISTORY.

For well over two hundred years this remarkable ignorance obtained, and as late as Victorian times professedly well informed scholars were writing that Europe owed nothing to India, stressing the point indeed, in at least one case, by referring to the Hindus as "Mongols,"³ an ignorance and indifference which appear extraordinary in a nation which has so close a connection with that vast country. Indian history in fact we practically said began with the

¹ *Quarterly Journal Calcutta Med. Soc.* 1837, i, p. 124.

² Jee. *History of Aryan Med. Science*, p. 38, and Bhava Mishra. Bhavaprakasha.

³ *British and Foreign Med. Review* 1847, xxi, p. 521.

English domination and before this was but a farrago of myths and legends.⁴ All Indian science was but a superstition, all its medicine but a matter of spells and charms. And this from English doctors who up to our own living memory were beginning their prescriptions with a traditional scrawl of the pious invocation "Jupiter be propitious to us!" It was indeed a literal case of the mote in our neighbour's eye.

In 1762 an epidemic of fever was ravaging India and a European doctor notes the death of thirty thousand natives in a single day; this exceptional mortality he explains was due to an eclipse,⁵ while other practitioners of his day were writing learned little notes on the effect of the tides of the sea upon the pregnancy of women. Be very sure that all these gentlemen were deservedly severe upon the absurd superstitions of Hindu so-called medicine.

THE CAUSES OF OUR EARLY IGNORANCE

Humiliating as it is for us to have to admit an ignorance at once so extraordinary and so self sufficient, at least our ancestors have a certain amount of excuse, and generally speaking it may be classed into three main groups.

In the first place Sanskrit treatises on medicine had been hitherto little noticed by Sanskrit scholars. The subject was not of general interest, and to translate these treatises in any useful manner would necessitate the translator being not only a perfect Sanskrit scholar but a physician as well. Further, the Hindu himself has a poor sense of history as we understand the word. Art, he says in effect, possesses no Ancient or Modern, and personalities have a poorer place than amongst ourselves. While to "William the Conqueror" every English child repeats the date 1066, in India it would be "Once upon a time there was a great King." This lack of attention to Sanskrit literature and the absence of discrimination in the historical sense may perhaps be regarded as the primary reason for our early failure to realise the existence of any medical history in India.

In the second place our system of classical education had already given us an apparent beginning for all the arts and sciences. A disproportionate part of our education was devoted to ancient Rome and Greece where we learnt all about Apollo and Aesculapius and in Greek history we came to Hippocrates. Here we had got a founder of medicine all ready for us, and that there might have been any one before him few of us were disposed to inquire. Certainly with all this good classical knowledge, so laboriously acquired, we were not prepared to venture still further afield, and most assuredly not into the and clouds of the story of a land which we universally regarded as both black and barbaric; so there we have reason number two for our appalling ignorance.

⁴ Eliot. *Hinduism and Buddhism*, 1, p. xcvi

⁵ *Quarterly Journal Calcutta Med. Soc.* 1837, 1, pp. 124-150

The third reason which brings us to the main thesis of our lecture is that about the time of the first European introduction to India, medical science in that country had fallen to perhaps the lowest point in the curve in all its long history, and so vast is the scope of this subject that it is only the fringe of it that I dare attempt roughly to trace.

THE DAWN OF HISTORY.

Into the question of the dates of the beginnings of Indian civilization this is not the place to go, for the truth is that with all our speculation we do not know anything definite. It was only some 120 years ago that we of the West first began to apply ourselves to the study of Sanskrit, and though since then whole libraries have been written upon the problems of Aryan beginnings, we cannot yet be satisfied that we have reached a definite establishment of truth.

Some there are who say that the great Aryan race had its birth-place amid the recesses of Central Asia, others hold on the other hand that it is rather to Scandinavia or North Germany that we should look for its origin.⁶

We used to be satisfied that the oldest Vedas dated back to perhaps 2000 B.C. Whitney, Grassmann and Benfey provisionally assume 2000 B.C. as the starting point of Hindu literature. Brunnhofer has suggested 2800 B.C., Prof. Jacobi of Bonn supposes the period to go back to 4000 B.C., while according to one school it may be that we should date them back to some even more remote glacial age when the very world itself was not the earth we know to-day. The Avesta, they say, points to an Aryan paradise that can only have been the North Pole, a region removed by tens of centuries from anything of which to-day we can have the least conception.⁷

THE MYTHOLOGY OF MEDICINE IN INDIA

However all this may be—and the issues raised are too vast for any discussion of an hour or so—we can but take the Vedic hymns as we find what remnants are left of them, setting them down as of immemorial antiquity. Whether the Rig Veda and the rest date from 1500 B.C., from 2500 B.C., from 4500 B.C., or from some dateless age even further back still, for present purposes is not our concern. Let us simply take the story as we find it, a story as plain as that of the school boy's Homer, without going into elaborate speculations as to who Homer may have been and when, and in the examination of this old story, we must remember that the value of mythology as a contribution to the study of ancient history is highly important. The philologist studies legends in order to fill the gaps in broken epigraphic compositions; the historian uses them to push back to their sources and to find a base whence he may move forward in search of reality. And so we find then that the Self-create

⁶ Whitney, *Oriental and Linguistic Studies*, i, and Müller, *Ancient Sanscrit Literature*, pp. iv-vii.

⁷ Tilak, *Arctic Home in the Vedas*, xiii, p. 414 et seq.

Brahma, having for the guidance of the universe written the Four Vedas and amongst them the Atharva Veda, communicated them to other gods, the two Aswins or sons of the Sun becoming the particular custodians of the Atharva Veda and thus the medical attendants so to speak of the hierarchy of heaven.

Next came the Upvedas or supplementary hymns designed for the more detailed instruction of mankind, and of these Brahma, taking compassion on man's sick, degenerate and suffering state, produced the Ayur-Veda which contained a treatise of the science of life.

The hymn itself in its entirety has perished and we know it but by fragments and comments in later Indian literature, but even from this second hand repute we are assured that for untold ages it was this Ayur-Veda that was regarded as the very foundation stone of Hindu medical science.

Then at some later period, after the deluge, the Vedas were lost and the plight of mankind became once more a sad and suffering one. Then the gods and demons, in order to recover the lost knowledge for the relief of the sufferings of mankind, having collected plants and herbs of divers kinds, cast them into the sea; they took Mandara the mountain as a churning stick: the god Vishnu, the second of the Hindu triad, assuming the form of a tortoise became the pivot upon which the stick turned; Shisha the serpent served as a cord and the gods on one side and the demons on the other alternately pulling on the serpent, churned the ocean until the fourteen gems or *rūtanās*, rose from the depths amongst which was Dhanwantari the god's physician and the Vedic father of medicine, with the cup of life-giving draught, Amrita, the beverage of immortality.

Dhanwantari, the Aesculapius of India, came to earth to minister to the misery and disease of mankind and to instruct them in the science of life. Unlike his brother Aesculapius, the Greek, he has not an attendant serpent, but is generally represented as a venerable old man with a book in his hand. The sages sent a deputation to Dhanwantari requesting him to teach them the science of life and amongst the deputation was Susruta, the founder of Hindu surgery, whom Dhanwantari selected to teach the Ayur-Veda and who subsequently wrote a famous book on surgery called the "Susruta Samhita."

As Susruta was the father of Hindu surgery, so Charaka, who also wrote a famous book on the science of physic entitled "Charaka Samhita," was the father of Hindu medicine. Susruta was essentially a surgeon and Charaka a physician and it is from these two teachers that the Hindus obtained their science of surgery and medicine in the years to follow after.

THE BEGINNINGS OF AUTHENTIC MEDICAL HISTORY.

We cannot say with any degree of certainty whether Charaka or Susruta was the earlier; from the point of view of literature the writings of Charaka



FIG. 1.—The Churning of the Ocean, or 2nd Avatar of Vishnu. Dharmantari, the Vedic Father of Medicine, the eighth of the fourteen Gems or Ratnas, appears on the left, facing the white shell.

(Copyright Wellcome Historical Medical Museum)

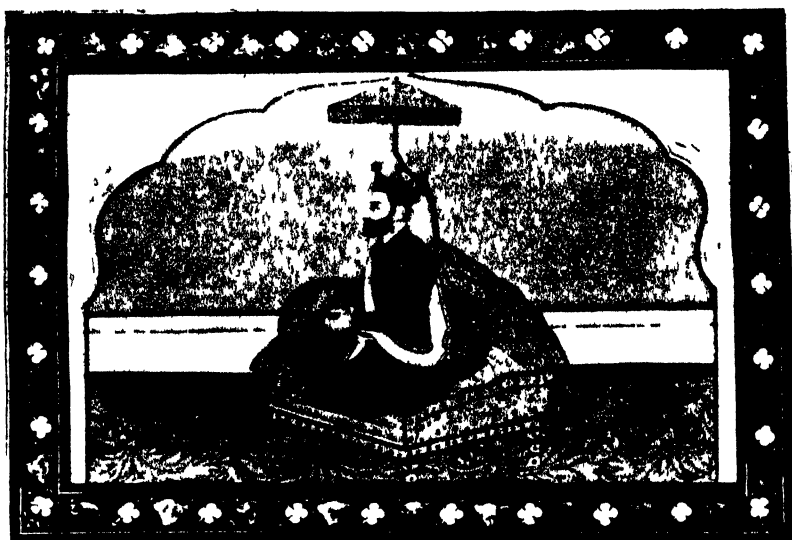


FIG. 1. Dhanwantari, the Vedic Father of Medicine, holding the bowl of Amrita or water of immortality.

(Copyright Wellcome Historical Medical Museum)

would appear to be of an earlier style * but among the ancients it seems to have been almost an axiom that surgery comes before medicine. Dr. Wise in his *Hindu Medicine* says: "Dhanwantari asked his pupils: 'On what shall I first lecture?' They answered: 'On surgery,' because formerly there were no diseases among the gods and wounds were the first injuries which required treatment. Besides, the practice of surgery is more respected as affording immediate relief and is connected with the practice of medicine although the latter has no connection with surgery. Surgery was the first requirement; illness only came later to a fallen mankind, being in fact a contribution for its own sins."

On these and other grounds it may well have been that Susruta preceded Charaka, but which of the two came first or whatever their precise dates may be, it is certain that their particular school of science were early enough to have been known and appreciated by other nations. The Arabians first mentioned them, and in turn were quoted by the Roman doctors. We later arrive at the "Indiscent" pointed out first by Professor Dietz in his *Proofs of the Antiquity of Hindu Medicine*. We have then at some rather indefinite but undoubtedly very early date a Susruta as the father of Indian surgery and a Charaka as the father of Indian medicine.

* Bhishagratna: *Susruta Samhita*, p. 181.

Wise: *Commentary on the Hindu System of Medicine*, p. 1.

And so we have the foundations of Hindu Medical Science in these two codes, to which we might presently add a third in the treatise called the Nidān or diagnosis, each of them in turn based upon the Ayur-Veda and quoting liberally from it and amplified in the Brahmana, or commentaries of the period one may term the Hindu Middle Ages.

DIVISIONS OF THE AYUR-VEDA.

The Ayur-Veda itself as we know it from its commentators seems to have been divided into eight parts, two treating of surgery, five of some branch or other of medicine and one of what was in later ages generally known as the Elixir of Life. The first dealt with the surgery of the removal of foreign bodies, of healing knife wounds, of bandages, blisters, and the proper treatment of inflammations and abscesses.

The second surgical chapter is concerned with the external organic affections of eyes, ears, mouth and nose. The third chapter, or the first medical section, has to do with diseases affecting the whole body, such as fevers and the like.

The fourth chapter is on ailments of the mind; the fifth has to do with the care of infants; the sixth with the administration of antidotes, the seventh with the medicines for restoring youth, and the eighth deals with how the increase of the human race could best be promoted.

"Chemistry" it is true may have been an Arabic word, but the science itself appears in India long before the time of the Arab scholars,¹⁰ for the seventh chapter of the Ayur-Veda treats exhaustively of this science.

These eight divisions of the Ayur-Veda are more or less followed in sequence by Susruta and Charaka.

SUSRUTA

Susruta, according to the Hindus, was the son of Vishvamitra a contemporary of Rama. Precisely when he may have lived we do not know. Sir William Jones places the subjugation of India by Rama about the year 2000 B.C. On the other hand some philosophic scholars assert Susruta to be a contemporary of the Buddha. As many Vedic hymns are ascribed to him it follows that he must have flourished during the Vedic Age. Again in the tenth book of the Atharva-Veda there is a hymn on the creation of man in which the skeleton is described according to Atreya and Susruta.¹¹ A large portion of the Atharva-Veda admittedly belongs to a period as early as 1000 B.C. and the hymn in question is included in the older portion.¹² This would appear to warrant the assumption that Susruta could not have flourished later than 1000 B.C. Nor have we got his original text; the Sanskrit version of what we call Susruta being

¹⁰ Wise. *History of Medicine*, I, p. xli.

¹¹ *Journal of the Royal Asiatic Soc.* 1906, p. 915, and 1907, p. 1.

¹² Hoernle. *Med. of Ancient India*. Part I, p. 9.

really a recension of recensions made at some considerable period after the late of the original.

Under his "code," to use a convenient even though not altogether accurate term, the eight books of the Ayur-Veda fall under six main headings. It is the two surgical chapters of the Vedas with which he chiefly deals, though as is common even to-day the surgeon also treats to some extent of medical ailments. The first of the six chapters is all surgery proper, but includes observations on climate and on food as affecting health. The second chapter deals with ailments brought about by vitiated humours; his third we might roughly translate as anatomy, his fourth as therapeutics, his fifth as toxicology and his sixth and last is supplementary, dealing with various local diseases.

It is, however, surgery in which Susruta specializes, calling it "the first and best of the medical sciences, less liable than any other to the fallacy of conjectural and inferential practice, pure in itself, the worthy product of heaven and certain source of fame." The irreverent layman would seem here to see the distinct forerunner of western theories.

BARAKA.

Very much the same considerations are to be drawn from the study of Baraka; who precisely he was and exactly when he lived we do not know. His "code," if we may for convenience call it so, is arranged in the form of dialogues between the master and pupil, the subjects with a certain lack of system apparently more or less suggesting themselves as they went along. A certain amount of the conversation is necessarily desultory, but its obvious object is the discussion of the subjects most pertinent to the benefit of mankind.

The first book, divided into thirty heads, deals with the origin of medicine and the duty of the physician, and here we can trace some sort of analogy to the oath of Hippocrates. The arrangements, properties and uses of medicine are each discussed and the cause, nature and prevention and cure of diseases. Diet, steam baths, the broad classification of foods—these are only a few of the subjects treated in this first book.

The second book goes on to describe diseases such as fevers, tumours, leprosy, mania and epilepsy. The third book considers the nature of epidemics, the peculiarity of the fluids of the body and other subjects. The fourth treats of conception, the variety of the species, the parts of the body and the connection between body and soul. The fifth book is a description of the organs of the senses, their peculiarities and ailments, affections of the speech, causes of diseases of organs, sudden losses of strength and death. The sixth book treats of the means of securing increased vigour and enjoying long life, and different classes of ailments are dealt with, as dropsy, jaundice, asthma, erysipelas, thirst and poisoning; inflammations, the effects of intoxication, abscesses, rheumatism and paralysis too, all find a place in this book.

The next, the seventh, treats of emetics and purgatives, and in its twelve chapters we see a remarkable number of such purgative medicines as were known to the ancient Hindus.

The last and eighth book, also in twelve chapters, deals with evacuating medicines for fevers, injections for various purposes, clysters and so forth. The arrangement to our modern ideas is often obscure, but that the sequence follows a system there is no possible doubt. With what we might call pure medicine is mixed up a good deal of mythology, and this too, helps to accentuate a certain lack of scientific system.

Notwithstanding blemishes obvious to the modern Western intelligence, the evidence of real knowledge is remarkable, and if we consider the position as regards this wonderful medical knowledge displayed at such an early date, it will, I think, appear obvious to us, that such a state could not have been attained in a day, but must have required long training and evolution, and would take these people back to the remotest antiquity. A little later on I propose to give many instances where this ancient Hindu science, under whatever term is chosen for its designation, medicine, religion or philosophy, actually antedates by centuries many a modern triumph on which present-day Western civilisation preens itself as the discoverer.

INSTRUMENTAL SURGERY

From these two, Susruta and Charaka, sprang many schools and sages. Dr Wise of the Bengal Medical Service writing in 1845 mentions two systems of Hindu surgery, nine systems of medicine, three of materia medica, one of nosology, one on pharmacy, three on metallic preparations. Of this formidable number at least four have left no recoverable trace, but from the others we can gather the strength of the scientific knowledge of the early India

The instrumental part of surgical treatment, they said, was divided into eight branches, to wit, cutting or incising, division or excision, drawing lines which corresponded to what we call scarification, and inoculation, puncturing, probing and sounding, the extraction of solids, the extraction of fluids and venesection and lastly suturing

For these diverse purposes the surgical instruments were divided into two classes, the Yantras or blunt instruments, and Sastras or sharp instruments. The Yantras which constitute the greater portion of the surgeon's outfit consisted of instruments such as forceps, specula, syringes, cupping appliances, probes, spoons, cauterics, etc. The Sastras consisted of knives of divers sorts for various purposes, needles, scissors and sharp probes. With these Yantras and Sastras went such appliances as thread, leaves, bandages, pledgets, and a variety of astringents and emollient applications, and these Yantras and Sastras were divided into no less than 125 separate classes. I hope in a few minutes to be able to outline some of the more striking.

HINDU ANATOMY

Before proceeding to give a more detailed description of these instruments, I wish, at the risk of apparent digression, to touch first on another point, the teaching of anatomy. From my preceding remarks it has I hope been obvious that the early Hindu surgeons must have possessed a very considerable knowledge of anatomy, and we find ourselves faced then with some difficulty in reconciling this deduction with the horror of modern India at even the touch of a corpse. When in 1836 English surgery was first introduced into India, only ten students could be found in the whole of the peninsula even to consider the prospect of dissection, and then on dry bones and on the skeletons of goats; the human body was taboo and it was not till one student—his name deserves to be remembered, MODOOSOODNA GUPTA—managed to lead the way by conquering his prejudices that any progress at all was possible.¹³ Even then the first dissecting room was specially built with high walls and was permanently under a strong police guard, so high ran local feeling. Children were said to be kidnapped, the sick to be murdered for the dissecting table; even in the England of a century back we seem to have heard similar tales! How then are we to reconcile a prejudice so intense with the fact of early Hindu anatomy? The solution is that the ancient Hinduism was almost free from this feeling which grew intense with the ages. In the Institutes of Manu,¹⁴ composed probably about B.C. 1200, we find a clue to the older law, "Mere bathing" it says "will purify after the touching of a corpse, while to stroke a cow or to gaze at the sun, if the mouth be but sprinkled with water, will remove the defilement due to the touch of a dead bone." It was under this earlier and easier code that Hindu surgery rose to its full heights.

The systems of anatomy fall roughly into three schools, those of Atreya who is reputed to have lived about B.C. 1200, of Susruta and of Vagbata who flourished about the second century B.C. While whole books could be written on the various versions and MSS. that are extant of the writings of these sages, we need only cursorily refer to the immense pains taken in their catalogues of the parts of the human body. A traditional recension of the statement of Charaka for instance begins as follows. "The body consists of the following parts, the two arms, the two legs, the head and neck, and the trunk. These made up the sexipartite body, inclusive of the teeth and nails it has 300 bones," which are then given in detail. It will be observed that Charaka looks upon the head and neck as being together but one main division.

In Susruta's table on the other hand we get a grand total of only 300 bones as he says "Surgical science knows only of 300 bones. Of these there are 106 in the extremities, 128 in the pelvic cavity, sides, back, shoulder and breast,

¹³ *Glasgow Med. Journal*, 1870-71, p. 51.

¹⁴ *Institutes of Manu*, Ch. V., v. 85, 87.

and from the neck upwards 66. In this wise the total of the 300 bones is made up." And then he proceeds to count them in elaborate detail.

The difference between that of Susruta and Charaka is probably accounted for by the fact that Charaka counted the thirty-two teeth and the twenty nails as separate bones. But, however these doctors may have differed as to their way of reckoning, there is no room for possible doubt that their system gave them a very thorough knowledge of anatomy, as indeed must have been necessary for the performance of the operations which we know were freely undertaken, some of them of the utmost delicacy. For not only were limbs amputated, but abdominal sections were performed, fractures were set, ruptures were reduced and foreign substances were dexterously extracted.

To Susruta is due the glory of the discovery of cataract-couching, centuries before it was known to the west, while the plastic surgery of skin grafting and rhinoplasty, only comparatively lately rediscovered in Europe, were frequently practised by the same great Hindu.¹⁵

His rules lay down exact regulations for the operating room; it was to be fumigated with such and such disinfectant vapours, a light refreshment was to be offered to the patient before certain operations, while before other operations he was to be fasting. The surgeon should keep his hair and beard short, his nails clean and close cut—a doctrine which has been rediscovered by our modern bacteriologists—and wear a clean, sweet-smelling dress.¹⁶ Even anaesthetics in some form or other were known, and at some later period we see in the Bhojaprabandha,¹⁷ a treatise written about 980 A.D., a reference to an inhalation before operation of an anaesthetic called Sammohini recorded to have been used in the time of Buddha.

THE DECLINE OF HINDU SURGERY.

Hindu medicine may be said to have reached its golden age at the commencement of the Buddhist period. Hoernle in his "Studies of the Medicine of Ancient India" says "According to the Indian tradition preserved in the Buddhist Jātakas or Folklore, there existed in India in the age of Buddha two great universities or seats of learning in which 'all sciences' including medicine were taught by 'professors of world wide renown'".¹⁸ These two universities were Kāśī or Benares in the east and the still more famous Takshasilā or Taxila on the Jhelum in the west."

Jivaka the famous physician who was contemporaneous with Buddha is stated to have studied medicine in the Taxila university.¹⁹

Owing, however, to various causes this golden age of Indian surgery was destined, like other golden ages, to fade away into silver and even baser metals.

¹⁵ Susruta. *Sutrasthānam*, Ch. XVI

¹⁶ Haeser. *Lehrbuch der Geschichte der Medizin*, 1, p. 3.

¹⁷ Ballala Pundit. Bhojaprabandha.

¹⁸ Hoernle. *Medicine of Ancient India*, 1, pp. 7 and 8

¹⁹ Rockhill. *Life of Buddha*, p. 65

The ceremonial prejudice against the touching of a corpse rapidly increased, and before long it was impossible for the student to learn his anatomy from practical first hand dissection. Bodies had to be laid out in water there to be rotted away till at last the skeleton was exposed. In this way only was it lawful to get at the bones. Dissection had to be made on goats, on anything rather than the human body. Anatomy then was being lost as a first hand knowledge. The surgeon under the Hinduism of what we might call the Indian Middle Ages was becoming a person unclean. In the *Manusamhita*,²⁰ the author forbids his readers to eat cooked rice from the hands of a doctor, by which he means a surgeon.

Again with no actual general anæsthetic (for it is probable that the inhalation I have just mentioned referred rather to some sort of doping into comparative insensibility) the patient was naturally averse to an operation if it could possibly be avoided, and so we begin to find various substitutes for the knife.²¹ Incisions were made by caustics and all sorts of cauteries and poultices were in use to avoid actual cutting; and as they avoided surgery so also they shrank from post-mortem examination and thus lost the last opportunity of testing diagnosis. The tide had begun to turn.

Before, however, tracing its further downward steps we might now take some general review of Hindu surgery and medicine as it was at its best, understanding of course that in a paper naturally limited in length it is impracticable to go into precise chronological details as to each individual point mentioned.

KNOWLEDGE OF THE ANCIENTS.

We find then that gravitation was known to the Hindus long before the birth of Newton and that the system of the circulation of the blood was discovered by them centuries before Harvey was heard of.²² Thus Hari²³ in the *Harita Samhita*, in a description of anæmia, observes that the disease is caused by clay obstructing the lumen of veins and so clogging the circulation of the blood. The atomic theory again was preached in India centuries before the birth of Christ, and their knowledge and comprehension of the sciences of mathematics and astronomy were remarkable.²⁴

With amputation came artificial limbs and in the *Rig Veda* we have such a reference.²⁵ An artificial leg, we learn, was made of iron; there were, too, artificial eyes. Rhinoplastic surgery I have already touched upon, and according to Dr Hirschberg of Berlin "The old plastic surgery in Europe had taken its new flight when these cunning devices of Indian workmen became known to us." The transplanting of skin flaps is also an entirely Indian method.

²⁰ *Manusamhita*, III, 152

²¹ Mukhopadhyaya *Surgical Instruments of the Hindus*, I, p. ix

²² Bhishagratna *Susruta Samhita*, I, p. ix

²³ Wise, *Commentary on the Hindu System of Medicine*, p. ix

²⁴ *Rig Veda*, XV, I, 110

In particular the Hindu surgeons were adepts at the forming of new ears and noses from the grafting of flaps of skin. The cause of much of their practice is an oddity that we might notice in passing, the cutting off of nose or ears being a common punishment for the criminal and for the unfaithful wife.

The Harley Street of ancient Hindu surgery seems then to have enjoyed a certain amount of what one might perhaps call divorce court practice !

From the *Mohāvāgga*¹⁵ we may learn that Jīvaka the physician of Buddha practised cranial surgery with success, and long before the birth of Jenner the cow-herds of India were practising a kind of inoculation or vaccination for small-pox.¹⁶ Collecting the dry scabs of the pustules they placed a little of these upon their fore-arm, then puncturing the skin with a needle, so securing a certain immunity. According to at least one scholar, a Dr. Huillet of Pondicherry, actual vaccination itself was known to the Hindu surgeons. So much then on the side of surgery.

The Hindu physicians were the first to devote their attention to the study of diseases and their treatment, and in medicine their learning in many cases far antedated our own, as was only natural from the immense study given to the properties of every product of the soil. The smoking of datura for example in cases of asthma we owe entirely to India, as also the prescription of nux vomica in paralysis and dyspepsia, and very largely the use of croton.¹⁷ Even the effects of excessive smoking come under the notice of the Indian physician.

In toxicology they had extraordinary skill and in the story of the invasion of India by Alexander, while all the Greek physicians were powerless in cases of snake bite the Indian doctors readily cured those who fell under this affliction. For this reason Nearchus says " Alexander collected round himself the most prominent of the Hindu doctors and proclaimed that any soldier bitten by a serpent was instantly to repair to the royal pavilion for treatment " ¹⁸ Their number of antidotes for different classes of case was extraordinary as might be expected from a science one of whose masters, Charaka, described in his teachings no less than 600 separate purgatives.

In the field of what to-day we should call Psycho-Therapy the Hindus again held pride of place, and centuries before Freud was heard of, the Hindu doctors were anxiously probing into the secrets of dreams. With much that we were taught to regard till quite recently as absurd, their teachings show signs of a good deal of our newest learning, and in for example the theories of the Terror Dream they came at least remarkably near our 20th century doctrine of the subconscious mind.

¹⁵ *Mohāvāgga*, viii, 1, 18 and Schneider, *Uncle's Tales*, p. 68

¹⁶ Ward *History of the Hindus*, ii, p. 330

¹⁷ Royle *Essay on the Antiquity of Hindu Medicine*, p. 61

¹⁸ *Arrian's Indian History*, ii, p. 232.

Again in midwifery the Hindu was well in advance, and his early writings display a remarkable knowledge of the technique of this branch of medical science, including cæsarean section and what we should now call pre-natal treatment. The expectant mother, it was taught, was to be kept in a happy frame of mind, her surroundings were to be placid and pleasant and in effect the instructions that the Mother-craft Clinics of London are giving to-day and have been giving for a matter of possibly the last ten years or so were being taught as a matter of course in the ancient India of centuries upon centuries back.

Medical hygiene occupied an enormous proportion of early Hindu practice, and the science of climatology at once so old and yet to-day so young was widely practised and understood. There were three distinct sorts of country, Anupa, the moist and marshy districts where "phlegmatic" diseases and "affections of the wind" would be prevalent; Jangala, the over-dry country where ailments of the "bile and blood" would be common and Mishra, neither too moist nor too dry, too warm nor too cold. Patients suffering from various ailments would be directed to try a different country, perhaps from Unupa to Jungala or vice versa, and Mishra would be recommended generally for the period of convalescence.²⁹

The codes laid down precise recommendations for the habits of patients of different types, the foods to be eaten, the clothes to be worn, even the hours for sleeping and for getting up. There was no province of human life, however intimate, for which recommendations were not to be found in the ancient Hindu medical code. What we know to-day as Preventive Medicine had its origins in India many centuries back.

The ritual cleanliness of the Hindu is well known, but long before the days when Brahmanism ruled every action of its votaries through the claims of caste and creed we may find the elements of the code in early Indian medicine. Take for instance so primary a case as the use of the tooth-brush (now taught in English council schools as quite a late example of 20th century western hygiene.) We find quite an elaborate set of regulations on the subject.³⁰ A twig of Bavala, the *Acacia Arabica*, was sufficient for general use, but for particular cases twigs of other woods were recommended, the Indian fig tree, *Ficus Religiosa*, for one case, the *Pongamia Glabra* for another, the *Naucllea Cadamba* for a third; in all no less than twelve distinct types of tree are singled out to provide tooth-brushes for particular types of users and there is a similar thoroughness about the regulations for the tooth-powder. We here in England having delayed the matter altogether for about twenty centuries have comparatively recently arrived at the point of oral hygiene and the use of the tooth-brush!

²⁹ Jee *Short History of Asian Med. Science*, p. 57.

³⁰ I-Tsing *Records of the Buddhist Religion*, Ch. xiii, p. 33.

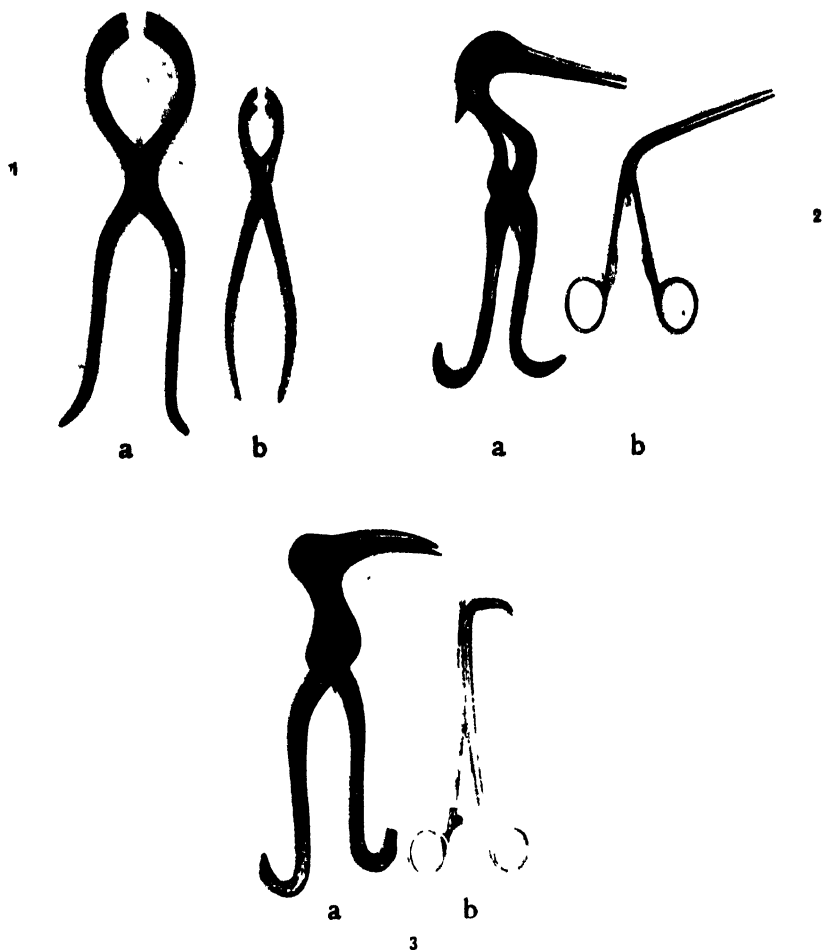


FIG. 4. A Comparative Series of Ancient Hindu and Modern European Surgical Instruments

- | | | |
|---|--------------------------------|----------------------------|
| 1 | (a) Simhamukha or Lion forceps | (b) Lion forceps |
| 2 | (a) Heron forceps | (b) Aural dressing forceps |
| 3 | (a) Cutlew forceps | (b) Ligature forceps |

(Copyright Wellcome Historical Medical Museum).

size and climate is indeed a veritable encyclopædia of the vegetable world? Nor shall we be disappointed. The materia medica of the ancient Hindus is a marvel to the modern scientific investigator, and that it was freely borrowed from by both Greeks and Romans cannot be denied.

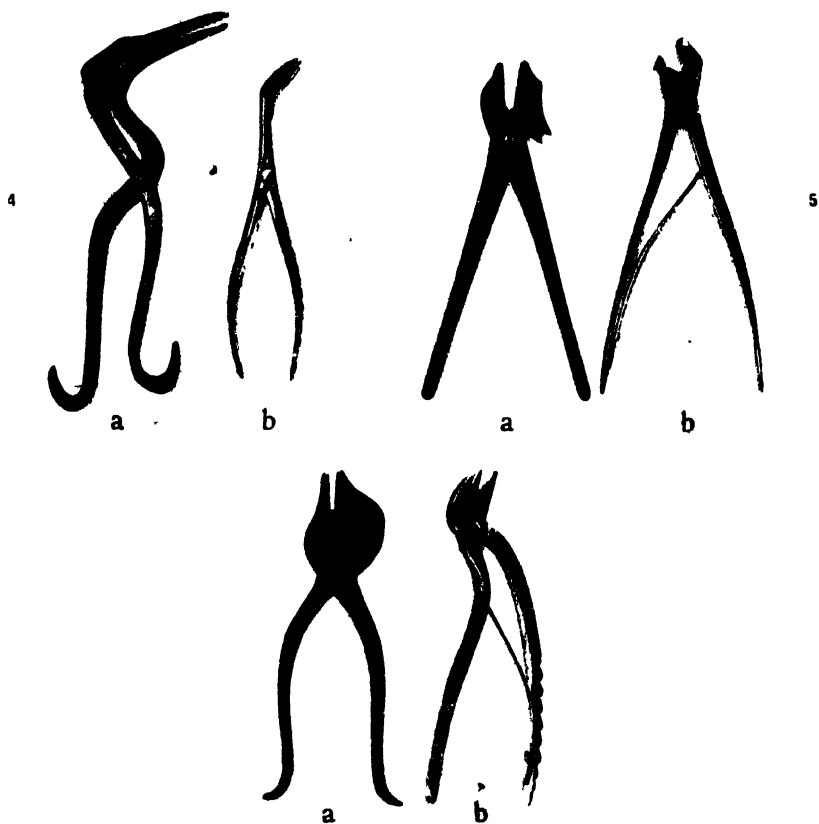


FIG. 5.—A Comparative Series of Ancient Hindu and Modern European Surgical Instruments

4 — (a) Crocodile forceps
5 — (a) Wolf forceps
6 — (a) Tiger forceps

(b) Bone holding forceps
(b) Skull forceps
(b) Gouge forceps

(Copyright Wellcome Historical Medical Museum)

Charaka makes an arrangement of "simple medicines" only, under no less than forty-five heads; Susruta, being more given to surgery, divides his medicines under thirty-seven heads. These masters passed on their teachings to their pupils who in turn supplemented them with new drugs, the fruit of their own experience. So we have Vagbhata about the second century B.C. and his stupendous *Ashtangahridya*, a sort of encyclopædic compendium of the medicine of Agnivesha, Charaka and Susruta; Madhava with his diagnosis

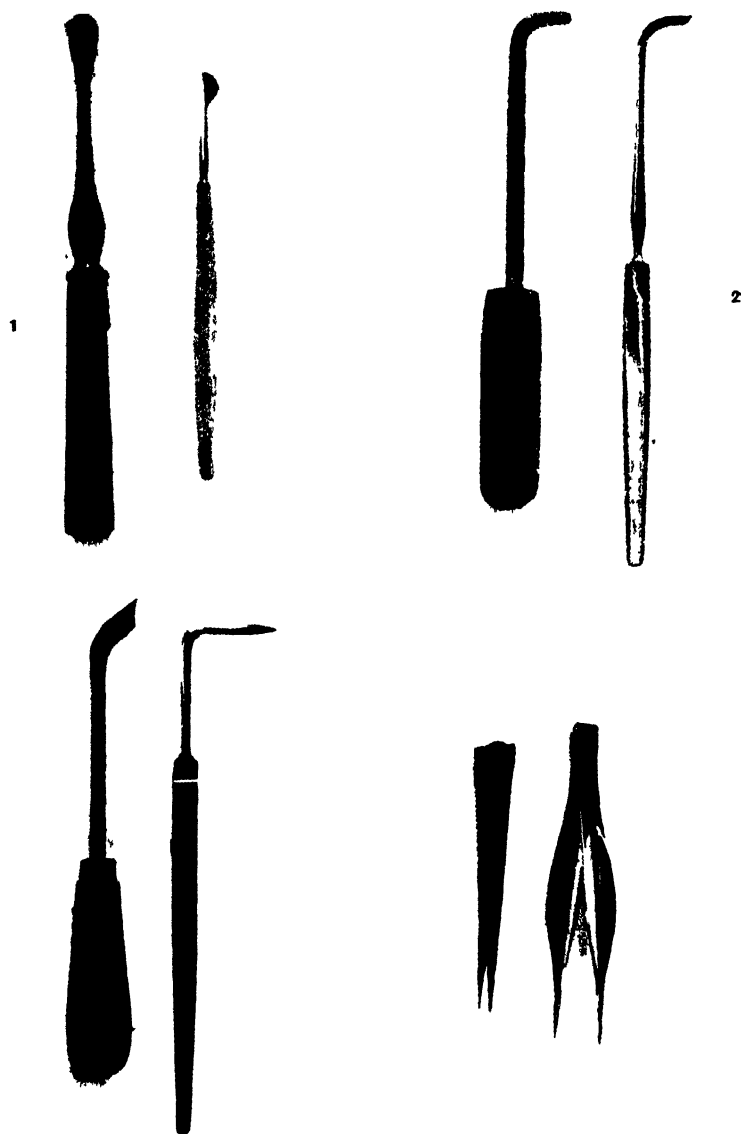


FIG. 1. A Comparative Series of various Instruments. Ancient Hindu and Modern
 1 — Indectomy knives 2 — Cleft palate knives
 3 — Cleft palate knives, double edged 4 — Splinter forceps
 (Copyright Wellcome Historical Medical Museum)

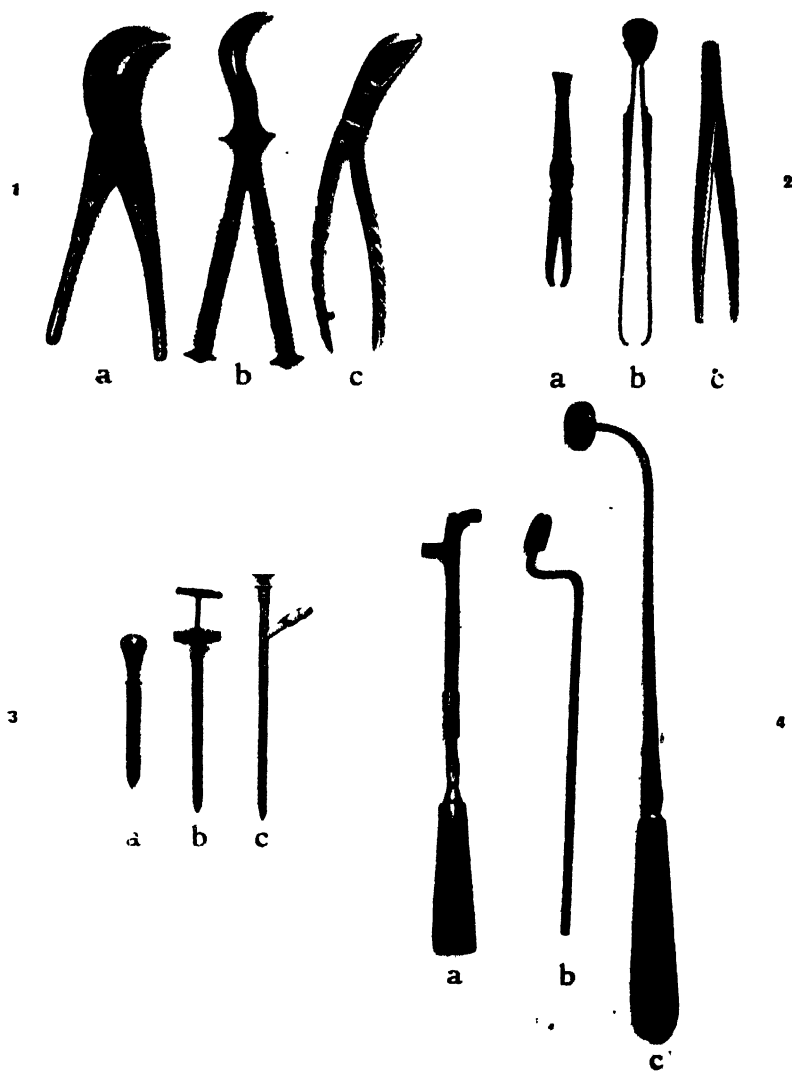


FIG. 7.—A Comparative Series of Ancient Hindu, Roman and Modern Surgical Instruments

- 1.—Bone Forceps. (a) Ancient Hindu, (b) Roman, A.D. 50, (c) Modern.
 2.—Long-toothed Forceps. (a) Ancient Hindu, (b) Roman, A.D. 50, (c) Modern.
 3.—Trocar and Canulae. (a) Ancient Hindu, (b) Roman, A.D. 50, (c) Modern.
 4.—Cauterizers. (a) Ancient Hindu, (b) Roman, A.D. 50, (c) Modern.

(Copyright Wellcome Historical Medical Museum).

of disease was another giant, and there was Bhava Mishra of Benares, the "Jewel of Physicians," and plenty more. The list of Indian medical writers could continue almost indefinitely.

In the *Materia Medica* are described drugs belonging to the animal, vegetable and mineral kingdoms, the theory being that every substance had to be judged by its five properties, Rasa, Guna, Veerya, Vipaka and Prabhava. The first of these stood for taste—sweet, sour, salt, bitter, pungent or astringent—the sweet being more restorative than the sour, the sour than the salt, and so on. The second property, Guna, was virtue, the inherent power of the drug to cause a certain effect when taken internally or externally; under this heading Charaka gives fifty groups of ten herbs each which he says "are enough for the purpose of an ordinary physician." Agnivesha, on the other hand, gives no less than 500 classes alone of medicinal agents. Veerya stands for the power of a drug, being either heating or cooling. Vipaka was the consequence of action or change which the drug underwent in the human organism, and finally Prabhava was its adherent nature or active force.

So two drugs might both be sweet, both be heavy and both be cold and both remain similar in consequence of gastric action, and yet in effect or Prabhava the one might be costive and the other laxative. With the combined action of these five properties, in the case of many hundreds of drugs as applied to different patients with different types of disease, the physician had to make himself familiar, for as the sages had it "Medicine when administered by an ignorant person is compared to poison, being like the knife, lightning or fire, but when administered with the necessary knowledge medicine is like the Amrita, or water of immortality."

The arrangement of *Materia Medica* in Susruta is curious according to our idea, medicines being either locomotive or nonlocomotive.²¹ Among the former fall animals whether viviparous or oviparous or "produced in moist places."

Long lists of medicines are hardly to our purpose, but in the *Kalpastānum* we might notice the classification of drugs and medicinal plants under their headings of Tuberous and Bulbous Roots, Bark of Roots, Bark of Trees, Trees possessing a peculiar smell, Leaves, Flowers, Fruits, Seeds, Acrid and Astringent Vegetables, Milky Plants, Gums and Resins. The list is interesting as it is in this book that we probably find our earliest notices respecting Botanical Geography, the sites and climates of different plants, the soils and seasons for collecting medicinal plants, the time that they remain good, how they are to be kept and the weights and measures of pharmacy. This Botanical Gardening coupled with the Indian pharmaceutical gardens which I shall refer to presently seems to possess a particular interest in medical history, and again it is to India that we owe it

²¹ Royle. *Antiquity of Hindu Medicine*, p. 53

Many of these medicines can be traced directly, not only down to the Arabs but also to the Greeks and Romans. Dioscorides in his first book mentions many Indian plants particularly among aromatics for which India has always been famed. Galen and Pliny also borrowed much, but it is the work of Dioscorides that is best calculated to show to how great an extent the ancients were indebted to India and the East for their medicines. There were some who used to think that the Hindus had their knowledge from the physicians who accompanied Alexander the Great on his conquests in the East, but we now know that it was to India that the Greeks, and so indirectly ourselves, owe most of their medicines. How this came about I hope soon to show. And while many drugs that had their origin in India have found their way into our own British pharmacopoeia, there were probably hundreds more Indian medicines still unacknowledged. Much as we have learned, it is possible that there still remain rewards richly to repay patient research.

THE INDIAN STATE SYSTEM OF MEDICINE.

With the coming of Buddhism practical surgery underwent a still further fall. The teaching of the Buddha, the Enlightened, did not, it is true, totally prohibit the use of the knife, and it was for instance permitted to lance a boil. But on the whole it is fair to say that surgery under the new creed was so shackled and hedged about with limitations that it almost disappeared.

The student was to practise puncturing "on the veins of dead animals and on the stalks of the water-lily," while his extractions were to be made experimentally on the pulp of various fruits and on the teeth of dead animals. Flowers, bulbs and gourds were all pressed into service as models for the dissecting table. Incisions were demonstrated on bladders packed with hair and paste, lancing on hollow stalks of plants, scarification on the fresh hides of animals "from which the hair had not been removed."²² Models of the human limbs were fashioned for lessons in bandaging, and so the regulations went on indefinitely. Little wonder that under letters so drastic the art of the surgeon should have experienced a retrograde tendency.

But while surgery was limited, other branches of medicine under the Buddhism that now ruled the greater part of India advanced by leaps and bounds. A creed of tenets that embraced in their care the veriest insects could but pay infinite care to the ailments and ills of man himself; and so we find the whole of India soon covered with a perfect net-work of medical machinery. In the scheme of life in fact of the Buddhist priest of 200 B.C. was included the assistance of the sick, and so we have hostels for the sick, the blind, and the deformed; there were hospitals for pregnant women, hospitals for travellers. Buddha Das, we are told, established the system of State Physicians, one being appointed for every ten villages on the great roads of India.²³

²² *Oriental Magazine*, Calcutta, February and March, 1823.

²³ Kern *Manual of Indian Buddhism*, p. 85 et seq.

Pharmaceutical Gardens were established to supply the herbs and drugs in Ayurvedic medicine. Arboriculture and irrigation were carried out under State supervision. In the line of Preventive Medicine laws were passed regulating burial and sanitation,⁴⁴ many modern regulations in the latter direction being antedated by centuries in the codes of the Buddhist Kings. The Royal Households set an example to their subjects in the direction of their houses and gardens. Medicinal herbs were grown in pots and certain plants were grown that had the property of warding off snakes; cats, peacocks and other creatures were kept in compounds for the same purpose, and parrots were encouraged on the grounds that their shriek was a warning of the presence of snakes. And anti-adulteration laws were drawn up on lines of strictest severity, and even carelessness on the part of a doctor was vigorously dealt with. "All physicians" the code said "who treat their patients wrongly shall pay a fine."⁴⁵ But as one commentator had it, "This refers to cases when death is not the result of the wrong treatment, for if that is the case the punishment is greater."⁴⁶

Under Buddhism veterinary science, as we might have expected, reached an enormously high level and infinite pains were taken for the care and treatment of the animal creation. Horses, elephants, cows, fishes, game-birds, almost everything had its veterinary surgeon; the game-keeper, the superintendent of forests, the superintendent of horses, each became a high officer of the Buddhist State.

Under the government of Chandra Gupta (c. 316 B.C.) our modern system of bird and animal sanctuaries was forestalled and whole tracts were devoted to the preservation of birds, fishes, deer and other animals that did not apparently prey on life. It was no case of Forest Preservation in our English history book sense of the Norman Conquerors. Life within the Buddhist reserves was literally and absolutely sacrosanct; the Little Brother of the Christian Saint Francis had veritably come into his own under the codes inspired by Buddha. Regulation after regulation was laid down dealing with the minutest details of the proper rations to be given to different animals at different ages, in sickness and in health, and over their ailments was lavished a care which centuries later a European peasant might well have envied. All over India at the height of the Buddhist wave were set up Animal Hospitals managed for the most part by the state and staffed by the state's own veterinary doctors,⁴⁷ the term is probably more accurate than that of the more obvious veterinary surgeons which almost came to my lips. It was the Apotheosis of the Animal World. Centuries later we can still find traces of these Animals Hospitals in various parts of India and particularly amongst the Jains. This then was the state of Medicine in India at one of its most glorious epochs.

⁴⁴ Law. *Studies in Ancient Hindu Polity*, p. 95 and *Megasthenes*, Bk. II.

⁴⁵ Vishnu. *Sacred Books of the East*, Clarendon Press, V, 175-177.

⁴⁶ *Mānu*, IX, 284.

⁴⁷ *Mānu*, IV, 220.

SPREAD OF INDIAN MEDICINE.

I hope that although with several digressions I have been able to interest you in the early medical science of India and at the risk of a certain loss of strict continuity to present something like a clear story of its glories. I am now anxious, if your patience permits, to touch upon its almost marvellous spread throughout the whole then-known world. For India was no Hermit State, and the knowledge of its Sages was a fountain-head from which every country has liberally drawn. As Jaccoliot remarks, "We should not forget that India, that immense and luminous centre in olden times, besides spreading its ideas throughout the East by means of emigration, from the earliest times was in constant communication with all the people of Asia and that all the philosophers and sages of antiquity went there to study the science of life."³⁸

As I have already tried to indicate, up to some century ago we assumed that Greece was the beginning of all things in medical history, and if anything at all came before Greece it was some dim immemorial Egypt of which we knew little enough. Any serious medical science that India may ever have possessed must have come, we took it, from Greece, probably from those Greek physicians who accompanied Alexander and his armies to the East. This was our old point of view. It was Dr. Wise whose researches first upset the theory, and who first dared to hazard the opinion that Greece and Egypt alike may both, in their scientific relations to India, have been the learners and not the teachers. As he puts it "Asia can benevolently give but it does not need to borrow; its ideas and fantasies are as exuberant as its vegetation."

To day the speculation is over and we trace how the great Pythagoras himself imbibed his mysteries from the Brahmanas of India.³⁹ The connection is not difficult. As long ago as the time of the thirty-seventh chapter of Genesis we find mention of the Ishmaelite or Midianite merchants trading with their caravans of spices of India and balm and myrrh of Hadramaut. Their traffic had its regular course towards Egypt and in this trade route of the remotest antiquity we arrive at some connection between India and the West. The Phoenecians, we know, had in the Persian Gulf their "forts" for the Indian trade, while as early again as 1686 B.C. the Arabs, we are told, had opened out a trade to India. Further, from the recent discoveries which have been made during the excavations carried out on the North West of India, we have ample evidence that as long ago as 3000 B.C. there was considerable intercourse, both in trade and culture, between the peoples dwelling in this region and those of Babylonia and Egypt.⁴⁰ In the East itself the Indian learning was carried to Ceylon, to Java, and later on to China and Tibet.⁴¹

³⁸ Jaccoliot *Occult Science in India*, p. 162.

³⁹ Bhishagratna. *Susruta Samhita*, i, p. viii and Berdoe, *Origin and Growth of the Healing Art*, p. 162.

⁴⁰ Ross. *Eastern Art and Literature*, 1928, p. 35.

⁴¹ Wise *History of Medicine*, i, p. xlv.

Buddhism came and the Brahmin priests fled to the furthest parts of the known world. The Buddhist Dynasties sank, Brahminism was recreated and Buddhist scholars, like those Greeks who with the fall of Constantinople brought the Renaissance to western Europe, fled with their learning to China, to Tibet, and further eastwards. There are even those who say that Ancient Mexico owes much of her pre-Conquistador civilization to the arts of India, and the discoveries made by Dr. Thomas Gann in his recent expeditions to Central America disclose in a startling manner the striking similarity of the design and architecture of some of the Maya temples to those of ancient India.

Hippocrates, the "Father of Medicine," we know to have visited India.⁴² For what? save the fame of the Indian physicians. According to a tale brought home to Greece at the time of Alexander the Indians had a doctor⁴³ whose skill was such that "he could raise the very dead."⁴⁴ Stories such as these however wildly exaggerated, speak wonders and in Greek medicine, in Arabian medicine, in what we know of Egyptian medicine, we find time after time traces of what can only have been derived from the even more ancient and famous Indian medicine. If we were to speak the truth we must call Greece not the parent of our modern medicine but its nurse. To Greece must be given the glory of nurturing and caring for the infant science, but its actual birthplace was in another country and continent.

THE FALL OF INDIAN MEDICINE.

Very roughly I have endeavoured to show the rise and glory of the Indian system of medicine. Its decline and total fall can be traced in a few final sentences. We have seen first how the development of the Brahmin ritual system fettered the hands of the Hindu surgeon, and then how the coming of Buddhism dealt him almost his death blow. And the creeds with all their virtues did even more than this. Various branches of medicine passed into the hand of the priests, and charms and amulets began to take the place of drugs and herbs. The doctor himself became a member of a sub-caste,⁴⁵ and not a particularly honoured sub-caste at that.

Where no fresh developments in anatomy or dissection were possible all reliance was placed on the learning of the past, and the letter of the learning rather than its spirit became the rule. And into even the letter of the ancient learning as expressed in the old manuscripts corruptions began to creep. The glories of Hindu science were in rapid decline. With the coming of the Moslem conquerors the fall became more rapid. The invaders had brought their own doctors, and if their science was in many cases taken from that of the conquered of centuries back, at least it was the science of the masters, and felt no need to take into consultation the science of the mastered.

⁴² *ibid* p. liii

⁴³ Yeemut ul-Twarikh

⁴⁴ Malcolm. *History of Persia*, i, p. .

⁴⁵ *Glasgow Med. Journal*, 1870-71, p. 3, 40

And so Hindu medicine again slipped down many grades. Where the Moslem Hakeems flourished under princely protection the Hindu Vaidyans held only the lowly offices of spell-makers to the poor.

With the coming of the Europeans—first the Portuguese, then the Dutch, the French, the English—the Kings of India, both Moslem and Hindu, were concerned rather with the protection of their territories, the raising of armies and the making of treaties, than with the care of science. The fire of Indian medicine had sunk almost to its last embers. The sneers of our pioneer writers at “spells and charms” were almost justified.

From 1715-1818 there seemed in the time of the Peshwas to be something like a faint revival of the ancient glories of Hindu medicine, but with the final victories of the English its hopes were extinguished, and as British rule spread all over the Peninsula European medicine was gradually introduced, and all that was left for the Hindu “Vaid” was about the position of an English herbalist. The Moslem Hakeems we might regard as Barber Surgeons, the Hindu practitioners as “Wise Women,” midwives and the like. To such a pass had come the learning of Susruta and Charaka.

In bringing my subject to a conclusion I think it would be of interest to note that of late years an effort has been made to revive interest and research in this ancient science, for the Hindu system of Medicine is still to-day a living science, and millions of people in India are at the present time being treated according to this method. A system which has so survived through the centuries cannot be lightly condemned as being unscientific, and a school of thought is at present engaged in trying to bring about a sort of renaissance of the Ayur-Vedic system of medicine. In Madras, Calcutta, Benares, Bombay and other cities there have been established training centres for this purpose where the works of Susruta, Charaka and other medical classics are systematically studied, so that we may have every ground for hope that before long the true Indian medicine may once again hold its place in its own India, the birth-place of the medicine of the world.

THE CHAIRMAN, in moving a vote of thanks to the lecturer, said he was sure all present had been thrilled by the lecturer's interesting account of ancient medicine in India. A curious fact which arose was the reluctance which had always been shown by great nations in the past to tell each other anything about each other, except occasionally about religion. The Arabs, like the Indians, had been supposed to have derived their knowledge of medicine from Greece, but long before the invasion of India by the Greeks there had been a great intercourse between Arabia and Mesopotamia on the one hand and India on the other, especially the sending of Arabs or Persians by the Caliphs to India in order to gain knowledge of discoveries made there in the direction of medicine and surgery. Another curious point was why the advance of knowledge in such things as medicine came to a sudden stop. In the ninth and tenth centuries, the Arabs were probably ahead of the whole world in medicine, but they had never moved any further forward in the science. It had been the same with the Persians. The Indians

too, had reached a certain stage of knowledge, and then had begun to fall back. He did not think that was to be accounted for only by caste having interfered with practical anatomy; he thought it was that they seemed to have reached a point, and then believed that the development of such things was not within the purview of anyone, and felt that they knew what there was to be known about medicine. The idea of improving in medicine was a comparatively modern one. With regard to kindness to animals, the lecturer did not mention the fact that the Jains had several places in India to which horses could be sent, not to be destroyed but to finish their lives quietly until they died. As to the dislike of the handling of persons, which had retarded medicine in the East, the Chinese used to have a curious system. In the Ming period the women refused to be touched by a doctor, so, in order to overcome the difficulty of diagnosis, they had constructed charming little dolls on which, when the doctor came, they pointed to that part of the body in which they themselves had pain.

SIR JAMES MACKENZIE, C.I.E., having seconded the vote of thanks, which was carried unanimously, the meeting terminated.

GENERAL NOTE.

AN EXHIBITION of architectural drawings likely to be of special interest to shop and store keepers and other business men, who contemplate the erection of new business premises on modern and original lines, is being held on the premises of the Incorporated Association of Architects and Surveyors, 1, Wilbraham Place, Sloane Street London, S.W., from Wednesday, the 10th, to Saturday, the 20th of July (open daily, excepting Sundays, from 10 a.m. to 5 p.m.) Admission is free on presentation of tickets, which are obtainable from the Secretary of the Association on application to the above mentioned address. The Exhibition consists of designs submitted in a recent competition, inaugurated under the auspices of the Association, for the front of a typical commercial building, and includes designs for premises suitable for drapery emporiums, stores, boot shops, showrooms, chemists, furniture and music shops, dressmaking establishments, etc. The competition, which has aroused considerable interest among architects and surveyors, as shown by the number of drawings submitted, had as its object the encouragement of new thoughts on the old problem of the combination of sane architectural treatment with the spacious windows and distinctive facade so essential to the occupier of modern business premises.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4000.

VOL. LXXVII.

FRIDAY, JULY 19th, 1929.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.(2.)

NOTICE.

COUNCIL.

A meeting of the Council was held on Monday, July 8th. Present:—Sir George Sutton, Bt., in the Chair, Sir Charles H. Armstrong; Mr. Alfred Carpmæl; Sir D. T. Chadwick, C.S.I., C.I.E.; Captain Sir Arthur Clarke, K.B.E.; Sir Edward Gait, K.C.S.I., C.I.E.; Major Sir Humphrey Leggett, R.E., D.S.O.; Sir Philip Magnus, Bt.; Sir Henry A. Miers, F.R.S.; Mr. J. A. Milne, C.B.E.; Sir Richard Redmayne, K.C.B.; Mr. Carmichael Thomas, and Lt.-Col. Sir A. T. Wilson, K.C.I.E., C.S.I., C.M.G., D.S.O., with Mr. G. K. Menzies, M.A. (Secretary), and Mr. W. Perry, B.A. (Assistant Secretary).

Mr. Llewelyn B. Atkinson, M.I.E.E., was elected Chairman of the Council for the year 1929-30.

The following candidates were duly elected Fellows of the Society:—

Atkinson, Henry Wallace, Brisbane, Australia.

Bourne, Frank A., Boston, Mass., U.S.A.

Chambers, Frank P., M.A., London

Eaton, Robert V., Toronto, Canada

Foster, Wilfred Lawrence, Mysore State, India

Hennessy, Jack F., B.Sc.A., M.I.A., A.M.I.E., Sydney, Australia.

Hornsby, Robert Wright, Santiago, Chile, South America.

Hunt, Walter, Townsville, Queensland, Australia.

Khakhar, Hasmukh Maganlal, Bombay, India.

Lawley, Alfred Leonard, A.M.I.C.E., Beira, Portuguese East Africa.

Newton, Captain James Boustead, Baghdad, Iraq

Patterson, Andrew Drysdale, Edinburgh.

Power, Richard Fitz, London

Walker, Robert Ransome, Keighley.

Watters, R. A., M.A., Sc.D., Assoc. A.I.E.E., Reno, Nevada, U.S.A.

Williams, Fleetwood Hesketh, London.

An offer from the Trustees of the Douglas Haig Memorial Homes to take over a certain group of cottages in West Wycombe and re-condition them as homes for ex-service men was accepted.

On the recommendation of the Examiner, the Thomas Gray Memorial Prize of £30, offered annually for competition among students of navigation

in the T.S. Conway, H.M.S. Worcester Training College and the Nautical College, Pangbourne, was awarded to Donald Edward Forman, Nautical College, Pangbourne. *Proxime accessit* Walker Harold Waghorn, of H.M.S. Worcester Training College, and Commended, Hugh H. Gordon Tracy, of the Nautical Training College, Pangbourne.

The various standing committees of the Council were re-appointed.

Sir Henry A. Miers, F.R.S., was appointed to represent the Society on a conference called by the Royal Anthropological Institute to consider the question of establishing a National Folk Museum.

A quantity of financial and formal business was transacted.

PROCEEDINGS OF THE SOCIETY.

NINETEENTH ORDINARY MEETING.

WEDNESDAY, APRIL 24TH, 1929.

PROFESSOR T. PERCY NUNN, M.A., D.Sc., Litt.D., in the Chair.

THE CHAIRMAN said the audience were met to listen to a lecture upon recent developments in educational broadcasting. That was a very important department of the work of the institution which was known everywhere with affectionate familiarity as the B.B.C. It was a wonderful institution, exercising from its mysterious den on Savoy Hill, and from its subordinate caves of mystery up and down the country, the most marvellous magic. Nobody would maintain that all its activities were beneficent or, at any rate, equally beneficent. He had heard no less a person than the Director-General himself say that when he heard the beginnings of some of the items of some of the programmes for which he was officially responsible he rushed across the room and cut out the loud speaker as speedily as possible. Yet, on the whole, there was no doubt that its magic was white magic; that it exercised an illuminating influence, and increased the happiness of that section of mankind with which it had to deal. In particular, it seemed as if broadcasting was going in the future to play a really important part in conveying to the darkest recesses of our social body some rays, at any rate, of the light which we called culture. The lecturer knew a great deal about the educational side of the B.B.C.'s activity. He knew it from two points of view: he was on the engineering staff and was therefore well acquainted with the technical side of the process, and he also had a complete understanding of the intellectual side of the business.

The following paper was then read:

RECENT DEVELOPMENTS IN EDUCATIONAL BROADCASTING.

By H. LINTON FLETCHER, B.A.

(of the British Broadcasting Corporation).

I wish to preface my remarks by saying that I do not desire you to suppose that my position at the B.B.C. qualifies me to make official statements regarding

either the Corporation's educational policy or regarding the considerations which govern the technique of educational broadcasting. It may be, however, that the advantage I have enjoyed of simultaneous contact with three aspects of the work—the Education Department, the technical problem, and the schools—will enable me to present a paper of general interest.

The British Broadcasting Company, under the Chairmanship of Lord Gainford, with Mr. Reith at its helm as Managing Director, came into being in the December of 1922. Its licence was granted in the first instance until the 31st December, 1924, and was subsequently, on the recommendation of the Sykes Committee, extended to the 31st December, 1926. It was stipulated at first that there should be eight transmitting stations, but before the end of 1924 eleven relay stations, a new main station at Belfast and a high power station at Daventry were added. It is important to notice that this new and powerful instrument came into being at a time when its great potentialities and far-reaching influences could best make themselves felt. Three years before the world was still rocking from the shock of the Great War. No department of State, no section of society, no industrial group but had been deeply influenced, if not metamorphosed, by the world catastrophe, and none more so than the world of Education. It was a time when everyone, who had not already given their all, gave of their best, and a time of sore trial for those faced with the task of public education. There were many who were still stunned by this triumphant demonstration of the thinness of the veneer of civilisation, but there were others happily who saw visions in the war clouds which still hung listless over our heads. A prophet of the times whose pen had already been dedicated to the service of education, wrote as follows:—

"We stand at an hour when the civilisation that bred us is sick—some fear even to death. We cannot escape from the duty of seeking a cure for its distemper any more than from the responsibility that lies in some measure upon us all of having brought it to its present pass. But however good our will, however happy our inspiration, the problems we and those who came before us have created are problems we cannot hope ourselves to solve. They must be solved, if at all, by the generations that will take up our work when our place knows us no more. To all who would fain believe that men are not wholly the sport of circumstance or the puppets of fate, but that their own wills shape the decrees which determine slowly but inevitably the doubtful doom of human kind, it must be important to be assured that though our children cannot build a fairer world on any other foundation than our own, yet they are not bound unless in our folly we will have it so, to repeat for ever our failures, that they have in them a creative power which, if wisely encouraged and tolerantly guided, may remould our best into a life far worthier than we have seen or than it has entered into our hearts to conceive."

It was in some such spirit as this that educational broadcasting was conceived. In December, 1922, the back-wash of industrial turmoil, so far from having abated four years after the signing of the Armistice, had rather lashed itself

¹ Dr. Percy Nunn: *Education: its data and first principles*.

into a fury, which was to reach its height four years later in the great strike of 1926.

The times were perilous, more perilous than our industrial political or religious partisans could possibly realise. And it was into this atmosphere that Broadcasting was introduced.

Of the difficulties that were primarily to be faced, the obstacles to be overcome, the rapid decisions that had to be made, the appalling responsibilities to be shouldered, I need say nothing here. Those of you who have read Sir John Reith's book "Broadcast over Britain" will already have some idea of the task which lay before them.



Play Readings.—Mr. Aubrey de Selincourt and his colleagues in the studio.

(Reproduced by permission of the B.B.C.)

I will content myself with saying that all the evidence I can obtain shows that from the outset the British Broadcasting Company took always the highest view of the potentialities of broadcasting in the widest cultural sense. Those who were responsible for its development were clearly determined that here should be no highly commercialised service, but that every endeavour should be made to secure that the potentialities of broadcasting should be developed in the service of the community and of the State.

It was in the month of October, 1923, that the first meeting of the National Educational Advisory Committee, including representatives of local education

authorities, directors and secretaries of education and various teachers' organisations took place. Public utility, that meeting was told, was to be the watchword of the Company. The field of education offered itself as one in which broadcasting, wisely governed, would play an enormously important part. At a second meeting of the Education Advisory Committee held in February 1924, Mr. J. C. Stobart, then His Majesty's Inspector, was present on behalf of the Board of Education in an unofficial capacity, and Sir H. Walford Davies, it is recorded, took a leading part in urging the institution of regular broadcast lessons, and it was decided forthwith that all stations of the B.B.C. should arrange for a series of six talks on music, Shakespeare, history, natural history, elementary science and travel. The Station Directors were to discuss programmes with their local advisory committees and with local directors of education, and the talks were to be transmitted on successive Fridays between 3.0 and 4.0 p.m. In May 1924, experimental series of educational transmissions were begun in Glasgow, London and elsewhere. These were the beginnings of the present service.

The Managing Director was clearly determined that nothing should be left to chance and that this work should not be handled by those who had no educational qualifications, and in the August of 1924, Mr. J. C. Stobart, who, from the earliest days of broadcasting, had himself visualised the great possibilities of broadcasting as a powerful medium for the dissemination of cultural influences, was seconded to the B.B.C. as Education Director by the then President of the Board of Education. A month later a regular daily transmission to schools began, and two evening talks daily, these latter being intended for ordinary listeners at 7.10 p.m. and at 9.40 p.m. Some of these took the form of a connected series, others were single talks intended to stimulate interest.

At a fourth meeting of the National Advisory Committee for Education, which the B.B.C. had set up, it was reported that there were then 220 schools known to be receiving the talks from the London Station. A scheme for adult education was drawn up in consultation with the Adult Education Committee at the Board of Education and a printed syllabus issued. In June, 1926, it is recorded that there were between 1,500 and 2,000 schools on the register at London. Of these approximately 70 per cent. were elementary schools, 16 per cent. were private schools, 10 per cent. were high schools and secondary schools, and four per cent. central schools. By this time an efficient service was in being. Many schools were sending in written compositions or answers to problems regularly, and terminal examinations had been instituted with excellent results.

In October, 1926, the Managing Director had occasion to address a conference of education authorities in Glasgow. In the course of his address he maintained that the period of the development of broadcasting coincided with a critical time in the history of education. "This generation," he said, "and that which

follows is faced with the urgent task of creating an educated democracy on a scale and to a degree never before attempted. The three main educational spheres in which broadcasting could operate he pointed out were the schools, the adolescents and the adults. He referred to some of the difficulties and said that those which arose from finance had been met in the past to some extent by the enterprise and keenness of teachers. The technical difficulties he explained can be dealt with to some extent (at least assistance could be given) by the B B C. At a later stage I shall discuss how some of these technical difficulties were met.



A class listening to Sir Willford Davies's music lesson. Note the blackboard notes, the follow-up pamphlets and the battery eliminator at the back of the class.

One of the very real difficulties with which the B B C was confronted about this time took the shape of an extraordinarily strong misconception on the part of teachers that wireless lessons could supplant them. Fortunately the majority realised that nothing could be a substitute for the personal element in teaching and that so far from being in any way antagonistic to the teachers' interests, the wireless lessons would prove of great supplementary value not only to the pupil by stimulating imagination, but also by suggesting fresh ideas to the teachers themselves. The issue of aids to study pamphlets

in which notes and suggestions were made for preparing and following up the lesson, did much to show the teachers that without their help and co-operation the lessons were foredoomed to failure.

Another difficulty arose from a certain hostility on the part of some who "didn't want to be educated." That was always a difficulty. Could Education have been called another name, could the intrinsic values of matter broadcast have been adjusted to every intellectual palate in proper proportions, the difficulty might have been obviated. But this was impossible. Fortunately the responsibility was not entirely with the B.B.C.

At the conclusion of the address to which I have been referring I find this paragraph. "The responsibility in short falls collectively on those charged with the task of public education. The B.B.C. is primarily charged with the development of broadcasting as a new medium of expression. It is only incidentally and of its own free will concerned with education. Its ability to help depends ultimately on the extent to which those interested in education will call upon it and on their willingness to create and express a public demand for the best and an appreciation of the best." That those concerned with education did call upon it and did demand the best, we shall presently see. In the meanwhile the B.B.C. was not going to lower its own view of its potentialities for disseminating far-reaching cultural influences. Moreover, they knew what they were about. They had put their hands to the plough and there was no looking back. Thus Sir John Reith in "Broadcast over Britain": "I think it will be admitted by all that to have exploited so great a scientific invention for the purpose and pursuit of entertainment alone would have been a prostitution of its powers and an insult to the character and intelligence of the people. To have left unexplored the innumerable paths along which might pass influences other than those normally associated with entertainment would have stamped as sorry fellows those to whose care the administration of the invention had been committed." These were the considerations which governed the policy under which educational broadcasting developed.

Hard upon the heels of a growing realisation that educational broadcasting would become a thing of great moment in the educational world came a proposal for the establishment of a joint committee of the British Institute of Adult Education and the B.B.C. Such a Committee was set up and met for the first time in October, 1926 under the Chairmanship of Sir Henry Hadow, Vice-Chancellor of Sheffield University.

The report of this Committee, signed on the 15th March, 1928, is obtainable under the title of "New Ventures in Broadcasting." I need not, therefore, ask you to consider it in detail now. In order that this part of my survey may not appear incomplete, however, I would like to draw your attention to certain parts of the report which are particularly relevant to my theme and which show how well justified Mr. Reith (as he was at that time) was in the expression of opinion I have quoted to you. "Broadcast education," the report tells us, "can appeal to those particular interests which mark off

sections of the public into particular groupings as well as appealing to the more general, more diffused interests." The following extract from a memorandum from the Workers Educational Association, which appears in the report, is, I think, illuminating. "Whilst the B.B.C. is probably under the obligation," it reads, "to provide for the needs recreational and educational of listeners as individual licence holders, it should not be forgotten that the experience of the voluntary educational bodies is that a large proportion of students get their inspirations for study from religious or politico economic associations, and desire education for the value it has in those connections." The memorandum goes on to deal with the question of how much weight can be given to this in broadcasting, and adds that the expression of these opinions does not carry with it a suggestion that subjects broadcast should be distorted to suit particular interests, "but rather that they should be treated as having relation to realities which various combinations of people are seeking to face and to understand."²

Here is what Professor Noel Baker, Cassel Professor of International Relations at the University of London says in "New Ventures." "The instrument of broadcasting is one that is peculiarly liable to prostitution to the purposes of political or national propaganda. It may be suggested, therefore, that it should be part of the conscious policy of the B.B.C. to endeavour to establish standards of thought on international subjects that will make such prostitution of broadcasting an offence which the public opinion of no country will tolerate." I will not weary you with details of the conclusions which the report sets forth. In brief it showed that the provision of recreation and entertainment has been and still is one of the main functions of the broadcasting service, but that it is impossible to draw a hard and fast line between the two. Opinions based upon the large quantity of evidence which had been called are given on the place of broadcasting in adult education and on the need for the formation of discussion groups in view of an "impressive and growing demand" that broadcasting should provide also facilities for more specialised adult education.

The fact that the value of broadcast education is of a supplementary nature is the key note of this and every other report that has been issued.

It will be understood that although the terms of reference of this Joint Committee were comprehensive, its chief work was the investigation of the relation between the B.B.C. and the voluntary bodies engaged in the work of adult education. School broadcasting, as such, was not within the scope of its enquiry, although the desirability of setting up a central council for controlling this part of the work is referred to in the report.

I have sought to give you some idea of the efforts that were made by the B.B.C. at this early stage to learn the views of adult education organisations with regard to educational broadcasting, and to show you how a balance was kept between the demand for entertainment and the growing demand for specialised talks. It must not be supposed that in the meanwhile the

² *New Ventures in Broadcasting.*

question of broadcast lessons for schools was being neglected—far from it. As we have seen, under the direction of Mr. Stobart regular transmissions to schools were organised and, early in 1927, in fact soon after the Company became a Corporation, an experiment was undertaken in the county of Kent with a view to doing in some measure for school broadcasting what the British Institute of Adult Education and B.B.C. Joint Committee's deliberations had done for the adult side. A report on this experiment which occupied the course of a year, was signed in May, 1928, two months after the issue of "New Ventures." This report, too, is available, but here again we must consider briefly the conclusions arrived at before proceeding to a closer consideration of the present position.

The Kent Report, as we have come to call the special investigation carried out in the County of Kent during the year 1927, was the result of a "growing feeling that some external investigation of the B.B.C.'s potentialities in respect of schools was extremely desirable."³ Kent was convenient geographically, and the Kent Education Committee offered every facility and encouragement. The United Kingdom Carnegie Trust provided a sum of £300 to help to defray the expenses of the enquiry, and £1,000 was obtained through private generosity. The scope of the enquiry covered elementary schools, and during the course of the experiment three conferences were held and were attended by representatives of teachers, representatives of the Kent Education Committee, of the B.B.C., and by H.M. Inspectors for the area. It was part of the B.B.C.'s intention in inaugurating this experiment in Kent to decide how some of the difficulties which had already been recognised and classified, might be overcome.

The technical difficulties at first were prominent. It was recognised particularly that the experiment could not be successful if any strain was imposed upon the children. This meant that good reception—that is to say, reception which enabled the children to hear every word of the lesson without strain or undue effort, was an essential. A service of advisory engineers (about whom I shall say more at a later stage) was provided, and every effort was made to secure that the conclusions to be drawn from the experiment should in no way be prejudiced by imperfect reception. I think the technical difficulties deserve a section to themselves, and I shall not dwell upon them here.

The report draws attention to the fact that Mr. Stobart's knowledge of elementary schools had led him to feel strongly "that the elementary school curriculum could be enriched by supplementary lessons."⁴ Contact with fresh personalities, records by eye witnesses of events described in the textbooks which the children used, a fresh voice, and a change from descriptive methods to which they had been accustomed, could not but stimulate the minds and broaden the outlook of the pupils. There would be, of course, an effect upon the teachers too. Such talks could not but bring the teacher

* See *Educational Broadcasting—a report of an experiment in the County of Kent*.

⁴ See Kent Report.

new ideas and suggest new methods of introducing old ideas. The Report amply bore out the feeling that in the supplementary value of the broadcast lessons lay their strongest claim, and the choice of subjects for broadcast purposes was governed by these considerations, the criterion of selection being the extent to which the various subjects could be so treated as to stimulate a desire for further knowledge and an enthusiasm for a closer consideration of subjects to which the children were already receiving an introduction. Such subjects, as the Kent Report records, were geography, where a traveller, such as Mr. Clifford Collinson, could relate his actual experiences in foreign countries; nature study, where the specialist's knowledge is of first importance; history, because this is a field in which the specialist can supply a first-hand and vivid background, and so on.



Sir Walford Davies broadcasting

(Reproduced by permission of the B.B.C.)

It was found that "there was a real and persistent demand from teachers for courses of wireless lessons in subjects associated with the ordinary subjects of the curricula." "In the opinion of the teachers," says the Report, "the broadcast lessons (a) imparted a knowledge of facts, (b) stimulated interest in ways which could be definitely observed, (c) created impressions as durable

as those produced by their ordinary lessons, (d) did not encourage inattention, (e) were particularly stimulating to clever children, (f) supplied views and information which the teachers themselves could not have supplied, (g) gave them fresh ideas for lessons, (h) interested some parents in the work that their children did in school." The Kent Report also tells us that the lecturer should be an expert, possessing some of the qualities of a teacher, and having some knowledge of the conditions prevailing in the schools of the type to which he is lecturing—that there is much to be done to ensure better co-operation between lecturer, teacher and pupil, that the teacher who takes charge of the broadcast lesson should not be out of sympathy with educational broadcasting, and that it is essential that efficient arrangements should be made for the upkeep of receiving apparatus. I am passing somewhat briefly over this important report because it is now over a year old. I do not think that on this account its conclusions are in any sense out of date, but we have learnt much in the meanwhile, and it is with this that I would rather occupy your attention.

In January, 1927, the B.B.C. had undergone a change in constitution and status, and from being a Limited Company it was reconstituted, following the recommendations of the Crawford Commission, as a Corporation by Royal Charter. The Board of Directors gave place to a Board of Governors with the Earl of Clarendon at its head, and the Managing Director became Director-General. Contrary to the fears expressed by many, neither the policy nor the programmes appeared to suffer materially. Educational Broadcasting became increasingly popular.

By this time the number of schools on the register had enormously increased, and contact had been made between the B.B.C. and education authorities and schools all over the country. Conferences and demonstrations had been given in London, Oxford, Liverpool, Kent, Bournemouth, Sheffield, in Scotland and in Wales, and by now the time was approaching when the B.B.C. felt that it was becoming desirable to set up councils to take charge of this side of the service. The report of Sir Henry Hadow's Joint Committee of the British Institute of Adult Education and the B.B.C. had suggested the establishment not only of a central council for broadcast adult education, but also one to take charge of Broadcasting to Schools, and the Kent Report ratified this suggestion.

Accordingly, in June, 1928, the National Advisory Committee to which the B.B.C. had looked for assistance in the development of school broadcasting decided to resign in a body so as to facilitate the setting up of the suggested council. An Interim Committee was appointed consisting of representatives of educational organisations, including the Board of Education, and of certain nominated members, with the object of making recommendations as to the constitution of the proposed council.

The Council has now been set up and is known as the National Central Council for School Broadcasting. It comprises twenty representatives of well-known and themselves representative educational bodies, and fifteen members nominated on account of their special qualifications for work on the Council. It was fortunate in persuading the Rt. Hon. H. A. L. Fisher, sometime President of the Board of Education, to act as its chairman.

Subject to the overriding power of the B.B.C. in regard to the terms of its Charter, the censorship of matter broadcast, questions of copyright, matters of broadcast technique and management, and finance, the Council has wide powers.

Meanwhile a Council for broadcast adult education had also been set up, and its powers were not dissimilar to those of the Schools Council.

This brings me in my survey more or less up to date, and I am now in a position to say something about the claims which can be made and the limitations which are recognised in respect of educational broadcasting to-day. So far I have been concerned very largely with history, and for the moment I am not going to leave this comparatively safe ground for the uncharted seas of conjecture. I am not at the moment concerned with my own views, and therefore in outlining the claims and limitations of educational broadcasting I cannot do better than quote them as they were expressed by Mr. Stobart to the Imperial Conference in June, 1927.

"(1). "Wireless can bring the pupils of the remotest schools within reach of the influence of experts and scholars of the highest standing.

(2). It can virtually add to the staff of a school by providing a fresh outlook and fresh voices. The effect of this upon the composition in the widening of vocabulary is very clearly marked.

(3). It can overcome the isolation of a school by enabling it to participate in such events as Armistice Day Celebrations in London, Evensong from Westminster Abbey, Empire Day, etc.

(4). It can be used in the evening as a medium of higher education, and a means of encouraging ex-pupils to pursue their studies.

(5). The exercise of concentrated listening to a continuous train of thought clearly spoken in good English is valuable mental discipline.

(6). The almost unlimited resources of broadcasting enable the B.B.C. to provide some things which no school, however wealthy and well staffed, could possibly provide, e.g., orchestral concerts, acting of Shakespeare by trained actors, travel talks by the actual explorers, etc.

On the other hand :-

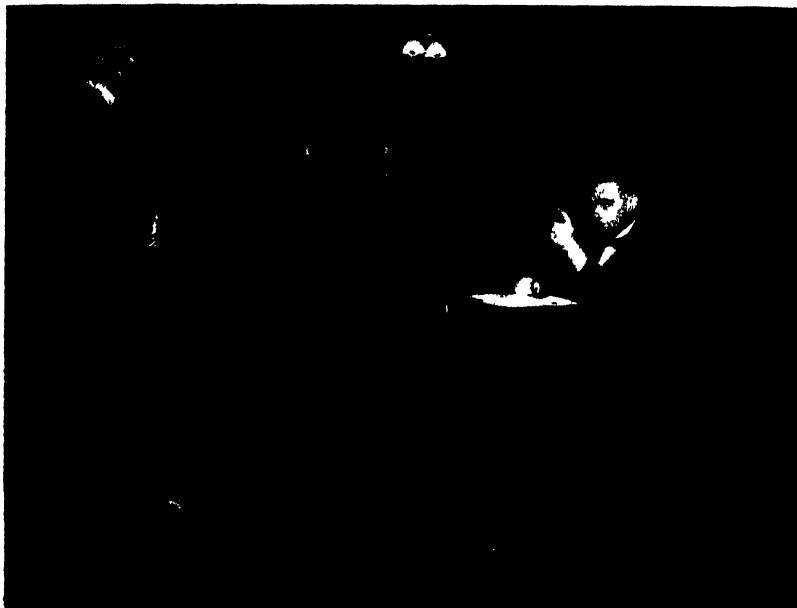
(1). Wireless cannot replace the living teacher. Indeed, it only attains its full effect when the teacher is able to co-operate by listening himself, correcting pupils' notes, clearing up points of difficulty and revising the wireless lesson to ensure that the points have gone home. For this purpose the B.B.C. issues printed pamphlets containing blackboard notes, maps, diagrams, etc.

(2). The wireless lesson must always partake of the nature of a lecture. The B.B.C. does not claim that the lecture method can play anything but a sub-

* *Educational Broadcasting*. A survey submitted by the British Broadcasting Corporation at the Imperial Conference on Education, June, 1927.

ordinate part in primary or juvenile education. For this reason the wireless lesson is placed near the end of the day's work, when it will be found to offer a stimulus and a change.

(3). There is some loss of personality through invisibility, but a great deal of personality can be conveyed by the living voice properly transmitted. Imperfect transmission is a fatal obstacle, and the B.B.C. has no desire to have classes listening on imperfect apparatus. It is the universal experience that where speech is transmitted, with its full quality, the interest of the class is well maintained.



Languages -- "Répétez après moi". M. Stéphan at the microphone. The announcer on the left of the picture is repeating the phrases *sotto voce* to signify the time required for the children to repeat

(Reproduced by permission of the B.B.C.)

(4). From the nature of things it is impossible for the B.B.C. to meet the needs of the time-tables and curricula of all schools. The areas they cover are far too great. They have to aim at a curriculum which will illuminate or consolidate the ordinary work of the average school. In languages, for example, the wireless lesson can hardly teach the whole thing from A to Z in the time available. It can give the voice and accent of a Frenchman as an aid to ordinary classroom tuition.

(5). It is only within limits that wireless can provide for expression on the part of the pupil. The B.B.C. invites teachers to send up samples of work, which are marked and returned. Praise at the microphone is found a valuable stimulus in many schools, but where teachers object to such honourable mention, they are in no way bound to submit specimens or to enter for examinations."

There have been and there still are difficulties to be faced. There are still, I am sorry to say, many people who really think that educational broadcasting can succeed without the teacher, that a loudspeaker can be introduced into the classroom and that the children can profit by lessons so heard. We feel sure that this cannot come to pass. The whole essence of the lessons lies in their supplementary character. Without follow-up work, without careful preparation and careful supervision, the talks would have little value. There have been difficulties, too, on account of time-tables and there have been cases, as the Kent Report relates, in which H.M. Inspectors have had reason to complain that too many broadcast lessons have been taken. It has been important to persuade teachers to realise that the intellectual fare provided has been intended to be taken, to use Mr. Stobart's metaphor, on an *à la carte* and not on a *table d'hôte* basis.

This brings me to the important consideration of technical problems into which I do not propose to go too deeply, though I shall try to show you how the B.B.C., when it was recognised that this was an important part of the whole, sought to give all the assistance that it could. Even in the earliest days of development it was realised that many technical difficulties would have to be overcome before the claims of educational broadcasting could finally be established. Good reception, always to be desired, would be, as I have said, a *sine qua non* when the attention of a class of children was to be focussed on the loud speaker for twenty minutes or for half-an-hour at a time. The B.B.C. realised this and resolved that although it could not lift both ends of the stick, the transmitting and the listening end, yet it would give practical proof of its anxiety to make its service of educational transmissions of maximum value, by investigating the technical difficulties at the listening end, and by giving such advice and assistance as it could.

In the autumn of 1926 an "education engineer" was appointed. His duties were threefold: (1) to raise the standard of reception in schools by giving advice and by making suggestions about how existing sets could be improved, or about how a set could be constructed on the right lines, (2) to answer teachers' inquiries about the claims of educational broadcasting, and (3) to collect and pass on to the sections of the Education Department concerned such information as could be obtained about the conditions which prevailed in schools and about the suggestions, criticisms, and difficulties which the teachers voiced.

That was two and a half years ago, and since that time the staff of education engineers, all having, in greater or lesser degree, the qualifications for duties to which I have referred, has been increased to fourteen, and it has become necessary to build up a small organisation to render their work of maximum value.

With the growth of this section and an amazing increase in the requests for assistance, the scope of this side of the work increased. It is not perhaps

for me to say that this fresh indication of the B.B.C.'s determination to help to make broadcasting a significant factor in the service of education, was tremendously appreciated by the schools. Nevertheless it is a fact, and when it became known that the B.B.C was willing to place the services of fourteen men, selected as far as possible for their combined knowledge of receiving apparatus, and the conditions which prevail in schools, at the disposal of educational bodies without cost to the schools, the demand for personal visits became enormous. The number of schools visited by request in 1928 alone was 2,276, at an average rate per week of 43.7, and in October of that year no less than 313 schools were visited (an average of 78 per week). What could be done by personal visits was supplemented by the issue of specifications for one, two, three and four-valve sets suitable for use in schools and by adult education organisations. These specifications, which have recently been revised and brought up to date, were and are made available free of charge to all who are concerned with the work. Assistance is given also through the post, and the work of dealing with the questions raised in this way occupies the time of a small staff at Head Office who are also concerned with the arrangement of the demonstrations to which I have referred, and of which there have been 117 up to the end of last year.

In the early days, of course, the technical problem assumed greater proportions than it does to-day. Many people had spent large sums on apparatus which was unreliable, and it was by no means uncommon to find children listening to broadcast lessons under incredibly bad conditions. In some cases a sort of *post hoc ergo propter hoc* confusion resulted in schools giving up the lessons as valueless, whilst in others, although the failure was rightly attributed to poor reception, it was not realised that a very much higher standard was obtainable. To demonstrate this standard became an important part of the duty of "Education Engineers."

Though this work is strictly confined to the education side of the service, it occupies the full time of the fourteen men to whom I have referred. The assistance is not confined to schools, of course, but is given also to adult organisations, though not to individual listeners.

Earlier in my paper I made reference to the earliest subjects which were chosen as being peculiarly adaptable as media through which a supplementary stimulus could be given to the pupils' imagination. I need not tell you about the courses which have been developed from these early ideas. The B.B.C. issues a programme and syllabus for both broadcasts to schools, and talks and lectures for adults -which can be obtained from the B.B.C.

I shall not have time to talk about Educational broadcasting in other countries. "Most continental stations," says 'New Ventures,' "arrange talks of a practical or of an educational kind in the day time." The talks usually last for about half-an-hour, and except in America, they are not of the same type as the short talks arranged by the B.B.C. "New Ventures"

tells us that by far the most important attempts outside Great Britain to utilise wireless in the service of education have been made in Berlin by the organisation known as the Deutsche Welle.

I have endeavoured—without, I hope, making my paper too long—to give you a brief survey of recent developments in educational broadcasting.

I hope you will forgive me for having dwelt so much on the expressed views of other people—and for having quoted so freely ; but the essence of a survey, as I understand it—is to put forward in palatable form, the bare facts of the matter.

Now—what of the future ?

To conjecture about the future of educational broadcasting is something which I feel neither able nor qualified to do. To attempt to read the signs of the times—especially as they are writ as large just now as at any time in history—and to suggest how broadcasting seems to lend itself to the service of education in a comparatively unexplored field is something I shall try to do.

In attending educational conferences one is struck by the amazing similarity between the high ideals which characterise the vast majority of presidential and other addresses one hears—and at the amazing support which—at the time—is always given to one Ideal in particular.

I almost wish I were a teacher so that I could, as Sir John Adams does—disarm criticism by reminding you that when Scott seeks an excuse for the errors of Reuben Butler he says " for the man was mortal and had been a schoolmaster." Fortunately, however, one can often pass on things to others which one may not oneself be credited with understanding.

A story is told of a parrot whose owner sought to teach it to talk. " Lieba Laura " he said to the bird each day as he sat before its cage, trying, contrary to all the best theories of heuristic methods to make it acquire something by vain repetition. The parrot was adamant. Its apperception masses were distinctly thin. Its owner, who had neither the patience nor the persistence of a Nunn, nor a Montessori, gave it a week. At the end of that time he wrung its neck and threw it, possibly, as a horrible example, amongst its cousins in the hen pen. Early next morning remorse shook him, and hastily dressing, he went out determined to atone in some degree for his hastiness by giving the bird a proper funeral. But the parrot was not dead, though six of his prize pullets were, and clinging triumphantly to the neck of the seventh was his parrot all cock-a-hoop, shrieking cacophonously into the unfortunate chicken's ear " say Lieba Laura, then, say Lieba Laura."

That is my apologia.

The ideal which is the keynote of so many speeches and addresses on education takes the shape of the aphorism " Individuality is the ideal of life."

In the past five years I have not heard a good speech nor read a sound book about education which did not either assume the truth of this statement, or seek to describe and elaborate methods of teaching to the end that individuality

might have scope to develop—as develop it does—in an atmosphere where there is an abundance of common interests and varied experiences.

It is an aphorism the truth of which is being impressed upon this generation as vigorously as is the poignancy of the unemployment problem.

Those who awake early in life to a fear that they are in danger of being intellectually equipped with bows and arrows to fight in a world where their elders and betters use powder and shot, dimly recognise that individuality is their heritage, and they seek it—or the atmosphere in which it develops—within the confines of their environment.

One does not have to be a student of the art of education to believe that Education must aim at the cultivation of individuality. It is a thought which pervades.

All our literature is full of it. Pestalozzi gave it to the World—Froebel philosophized about it and developed it, Herbert wove a Psychology round it; Montessori is full of it. William James never allows one to forget it. Sanderson of Oundle applied the principles which underlie it as, in a lesser degree, Thring of Uppingham did before him. Every psychologist, philosopher and school-master writes and speaks of it. Only those whom Professor Laurie brands as “Teachers by the Grace of God” fail to see it.

There are some things in life so overwhelmingly convincingly *right* that one does not question them. This is one of them—this idea that the real aim of education is the cultivation of character and the preparation of man's environment, to the end that his individuality may have complete freedom to develop.

It seems unthinkable that any other lesser considerations should govern our systems of education. But they do. They have to.

Those charged with the task of administering public education are faced with a grim task—about half a million children pass out of our elementary schools annually. They have to be intellectually equipped to live and move and have their being in a certain environment, the nature of which can often be anticipated. It's all very well to talk of giving their individuality opportunities of developing—it's of precious little use to them without the three R's. They have to earn their bread and butter in a world where individuality isn't at a premium.

The problem is one which has been recognised and faced. Great efforts have been made so to adjust the values of subjects taught at various stages of development that neither the knowledge which the child acquires nor the experiences from which his power to form judgments is obtained should be ineffective in making him a useful member of society.

What is known as the problem of post-primary education offers the greatest difficulty. The Haldane Report (The Next Step in National Education) confirmed the growing feeling that from the age of eleven onwards all normal children needed “schools of a new type adapted to their varying needs and capacities.” The report tells us that “This problem of liberalising the

curriculum and of bringing it into closer relation with the realities of the world and the interests of the pupil, will become ever more urgent as secondary education extends and includes a larger proportion of the adolescent population within its range."

Fortunately broadcasting is not faced with the same task. It is not concerned with the task of Public Education and it is therefore all the more free to fulfil this long felt want.

The Report speaks of bringing the curriculum into closer relation with the realities of the world.

Surely this is just what the broadcast lessons are designed to do?

The supplementary courses arranged in connection with the teaching of History and Geography are typical examples. It would be hard to imagine anything better calculated to make a realistic appeal to the imagination than one of Mr. Clifford Collinson's travel talks coming on top of a sober study of the geography of the places he describes.

Dr. Nunn in "Education: its data and first principles" reminds us that "a normal child's appetite is as varied as it is vigorous, and that it can rarely resist the temptation to emulate another's exploits, so that it is not often difficult to make him take his intellectual meals provided that the fare is properly chosen and attractively set out."

Broadcasting provides a medium through which the child can come in real contact at first hand with just such exploits. As for choosing and setting out the meal attractively, I can only tell you that to watch a class of children listening to Miss Rhoda Power describing a country fair in the middle ages is a sight that does one good.

"Data and first principles" also tells us that individuality only develops in a social atmosphere where it can find common interests and common activities.

Broadcasting can help to create that atmosphere.

The Armistice Day Ceremony; the Broadcast from the Menin Gate; events of great national significance—these are of the essence of common interests. It is through such things that we learn to unite in a common bond—we and our children. This way lie the means of inculcating ideals. "Art and literature," writes William Chandler Bagley in "The Educative Process," "poetry, the drama and fiction, music and religion, are the great media for the transmission of ideals and as such fulfil an educative function far more fundamental than our didactic pedagogy has ever realised."

I am not making a play on the word transmission—but none of these things—neither poetry, drama, music, religion nor fiction, are omitted from the programmes.

It is unfortunate that since the connotation of certain terms brings a sort of standardised denotation in its wake, we cannot change them altogether. Education for instance. For many of us it has come to denote an uncongenial atmosphere in which textbooks, time-tables and examinations predominate

* just as the term religion still, alas, conjures up for many an atmosphere redolent only of churches, prayer books and controversy.

Those who have studied the principles of Montessori as applied to children, or the Dalton plan as applied at a later stage in life, have found that this tendency to put education into a separate, definite, uncongenial category has been a great obstacle, just as our real religious reformers rank as their greatest enemies those whose religion is brought out on the Sabbath to be burnished up for the edification of their neighbours.

Broadcasting does not lay the emphasis on the formal values of its subject matter. There is an appeal to the imagination. "We should take the child seriously," says Dr. Nunn, "as he takes himself, as poet, or dramatist, engineer, surveyor, chemist, astronomer or sailor, and should help him to explore as fully as he craves, those concrete modes of self-assertion. . . . His studies should be so shaped as to help him to be in imagination and in anticipation a sharer in those phases of human effort which have most significance for civilisation as a whole. His history and geography should look largely towards politics in the wider sense, and economics. His science should make him a fellow worker with men like Pasteur; his mathematics should teach him the value of abstract thought in relation to the practical affairs of life, for teaching given in the spirit thus indicated makes as direct an appeal to the play motive in the adolescent as the invitation to make believe does to the child."⁷

I suggest that along such lines as these broadcasting can do a tremendous amount to bring children, through the ordinary subjects of their curriculum, and without interfering with their vocational studies, into touch with the realities of life.

The rector of a parish in Llandudno, in the course of an address delivered at Easter to members of the National Union of Teachers Conference, remarked that all the history he could remember was William - 1066. He would not have minded so much, he told us, if only they had told him *why* he should remember William - 1066. But that was in the days when, as Sir John Adams puts it, in order to teach John Latin one had to know Latin, but not necessarily John.

You see I have unblushingly torn from their contexts some of the utterances of our educational psychologists with whose writings you are no doubt very much more familiar than am I. But you will agree that this is a field in which broadcasting has an important part to play? And even if some of the aphorisms I have quoted were not meant to stand on their own feet, do they not take on a new significance with the potentialities of broadcasting as a background?

The method of illustrating my point is, I hope, at all events, preferable to voicing metaphors, which, as Adams puts it, have a way of getting the bit between their teeth and leading one far from the point. Broadcasting can

⁷ Dr. Percy Nunn, *Education: its data and first principles*.

do much to make this ideal of education—the cultivation of character—a more tangible thing.

William James, writing on the things that make a life significant, reminds us that "life is soaked and shot through with values and meanings which we fail to realise because of our external and insensible point of view."^a

The first-hand experiences which broadcasting can bring us must surely render our attitude towards life less external, less insensible, less "aloof?" You can't hear Sir Walford Davies explain the language of music and afterwards hear the Unfinished Symphony without getting a glimpse of the meaning and the values it holds for other people?

There is a grave absence, we are told, in the life of the nation of three essential things—fixed principles, comradeship, and vigorous aspiration.

We are wont to say that the cataclysm of 1914-1918 was a war to end wars; that never again would man submit to such a useless, hopeless, horrible annihilation of all that is best and greatest. How many of us really believe that we are as far away from the possibility of a repetition of anything of that kind as we would like to believe? Most of us have an amazing tendency to refuse to see things we do not like seeing, and to refuse to hear things we do not like hearing. I do not think, however, that anyone to-day would deny that there is still much to be done to supplement the curriculum and to brighten the environment which are the heritage, thanks to our education Acts, of all children to-day. Broadcasting can play a great part in teaching children, and grown-ups, too, not only what to think, but how to think, in showing them, if possible, that such things as prejudice and bias, which lie at the root of all our trades and industrial disputes, are, after all, but forms of psychological phenomena which, like complexes, have only to be explained to be understood. Broadcasting can help us to know how to set about seeking the truth that sets us free—it can teach us what William James tells us is the first thing to learn in human intercourse: "non-interference with each other's peculiar ways of being happy," and it can teach us—again I must turn to Dr. Nunn—"that freedom for each to conduct life's adventure in his own way and to make the best he can of it is the one universal ideal sanctioned by nature and approved by reason;" That broadcasting can bring us nearer to that ideal I am certain.

It rests with the teachers.

I wish to make my acknowledgements to the B.B.C. for permission to read this paper, to Captain C. G. Graves for his valuable comments, to Mr. Bishop (also of the B.B.C.) for reviewing my references to the work of Education Engineers, and to Mr. E. M. Rich of the Education Department of the L.C.C. for his advice.

^a *Talks to teachers on psychology and life's ideals.*

^b Dr. Percy Nunn, *Education: its data and first principles.*

I am also particularly glad to have this opportunity of placing on record my sincere gratitude to Mr. Stobart, B.B.C. Education Director, without whose personal friendliness, advice and guidance in the past two-and-a-half years it would have been impossible for me to have attempted a survey of this kind.

DISCUSSION.

THE CHAIRMAN said the audience would agree that they had heard an extremely interesting survey of the educational activities of the B.B.C., and a very able *apologia* for them. The lecturer's text had been very interesting, but, personally, he ventured to think that he had been even more interesting when he had got away from his text. The lecturer had dealt so comprehensively with the problems of broadcasting that it would be impossible for anyone to follow him through the paper even with the briefest comments. His (the Chairman's) best plan would be to confine himself to pointing out how broadly the lecturer had treated the question, and in what a modest spirit, as an official of the B.B.C., he had dealt with the problems which that Corporation had to face. In particular, the audience must have been struck with the way in which the lecturer insisted that success in broadcasting was not a matter for the B.B.C. alone. It was essentially a question for co-operation between the Corporation's officers and the schools. There was an educational technique of a definitely new kind to be worked out, and the Corporation was fortunate, and the education of this country was fortunate, in that attempts to work out that technique were being fostered by young men so able and enthusiastic as the lecturer.

CAPTAIN P. P. ECKERSLEY said he did not know if the audience realised the relative positions between the lecturer and himself. Personally he considered the lecturer was neither flesh nor fowl nor good red herring at the B.B.C. The lecturer was partly on Mr. Stobart's staff looking after education, and he was partly on his (Captain Eckerley's) staff looking after the technical side. Whenever Mr. Fletcher did anything really good, and was worthy of being on the engineering side, he immediately said to him, "Wonderful!" When, however, the lecturer did something of which he (Captain Eckerley) did not approve, he said, "Oh, those educational people!" On the present occasion, however, the lecturer was definitely on the technical staff!

Those present had listened with great instruction to the lecture. Personally he had learned a great deal about the educational side of the work. He knew perfectly well why Mr. Fletcher had left out the technical side. It was because he expected himself to deal with that side, feeling for once that he was boss. However, he was not going to say anything about the technical side at all. He was going to challenge Mr. Fletcher upon his own ground, because he felt that nobody who opened a discussion should, by any manner of means, agree with the lecturer in any way! There did seem to be a different point of view which one might take up about the whole of the broadcasting service. He would challenge Mr. Fletcher by asking him: Was it really necessary to insist upon the educational side of broadcasting, when the broadcasting service, run properly, was essentially educative in itself? What he meant was that the very fact of playing a symphony, of allowing a certain person to talk, of having a cultural ideal behind broadcasting, gave it an intrinsic value, and made broadcasting educative by little homeopathic

doses so that people hardly knew they were being educated. And one wondered if that was not the best way of educating people. One wondered, in fact, if the label "education" did not cause more "clicks" throughout the country than any other word in the language. Very stupid people said, "When I come home in the evening I want to be amused; I do not want any of your education; I am tired, and I want to listen to a good old military band." Such people were probably perfectly sincere. Directly it was stated that there would be an educational talk, they "clicked." It was possibly in the wrong spirit to say to such a man what was said by the lady in *Punch* who was taking her child out for the day. She was dragging her little girl, who was crying bitterly, along with her, saying: "You have come out to enjoy yourself, and enjoy yourself you will, you little beggar." Personally he often wondered if the label "The educational hour" did not tend, to an extent, to destroy the good which might be done by gentle insinuation. It was such labels that made people say, "I resist this thing," whereas they could be brought to an unconscious enjoyment of it. It should be pointed out to them that, really and essentially, amusement was education.

The first time a man heard a difficult piece of music he said, "I did not enjoy that at all," but if it was a good piece of music, and he persisted in listening to it, he would soon get to enjoy it. For instance, when he himself had had his first whisky and soda he had thought it was filthy, but he had persisted—and persisted so much that he could hardly now do without it. It seemed to be very much the same with the B.B.C.'s educational work. At first it might be thought nauseous, but in the end become to be looked upon as invigorating stuff sent into the minds and ears of the listeners, who would eventually find themselves educated without knowing that they had been. Therefore he asked Mr. Fletcher if it was really necessary to go round to the schools, to insist upon formal education, to label things too much, to make a formal song and dance about it, when it might be intrinsic in the whole affair?

He was second to none in believing that broadcasting had an enormous future before it. Broadcasting, properly handled, could give a leadership as nothing else in the world could. It had possibilities and potentialities greater even than those held at present by the commercial and competitive press. The press of this country were under the terrible obligation of getting advertisements, of making profit and of going down to a certain level because they had to be competitive one against the other. Broadcasting had none of those disabilities. He would utter a serious note of warning in regard to broadcasting, and that was that its responsibilities were so enormous that it must not go to the other extreme of getting a superiority complex. It must realise that it was in the end a thing which should have a leadership, which should have a conscious ideal that should not label itself and that should not be too organised or too formal, but which still had to remain human if it was to get the confidence of the people who listened.

That was his criticism of formal education—that it was taken with a measure of suspicion by people. If he might suggest it to the lecturer, possibly more good would be done without too many labels, without too many principles, but with a good deal of humanity. That was his sole challenge to Mr. Fletcher's most instructive lecture.

There was a technical scheme at present under discussion which would enable the particular work of Mr. Fletcher and his colleagues to go forward with great rapidity and give more flexibility to it. The Corporation were trying to arrange a scheme throughout Britain whereby every person could have an alternative programme. The first station was being built in London. There would be other

stations in Manchester, Glasgow and Cardiff. The Corporation would soon be able to guarantee to every listener throughout the British Isles the choice of alternative programmes.

SIR RICHARD GREGORY said there was a very great work to be done by the B.B.C. in regard to educational broadcasting if only the word "educational" could be got rid of. It was curious how the English people disliked the idea of being educated. There was quite a different point of view towards education and everything relating to it in Scotland and in Germany. The view which the B.B.C. had in inaugurating such educational talks was to inspire interest in subjects not usually included in the curricula of secondary or other schools. As he understood it, a speaker from Savoy Hill occupied much the same position as the itinerant lecturer who was brought in from time to time. Nothing but good could come from that kind of talk, assuming, of course, that it was not part of the ordinary school work. It was when one attempted to make those talks work, with the pupils set definite exercises upon them, and instructed to make notes upon them in the course of their ordinary lessons that one was faced with certain difficulties which were obvious to every teacher. Teaching a class was very different from lecturing. It was impossible for any talk to be more than a lecture, unless one could create some new kind of attitude on the part of the teacher towards it - a teacher who was going to be a kind of transformer himself of the information given in a talk, and to use that for his own purposes in lessons.

As one who had listened in a good deal, he could not help but marvel at the variety in the character of the programmes which were provided. A most important influence had been exerted by the B.B.C. in cultivating an appreciation of what was worth while. It could still be expected with confidence that the B.B.C. would carry on its great work by influencing the minds of all who listened in. The B.B.C. would eventually arrive at a means of using that "voice out of the ether" to carry into the human mind thoughts of the highest type which would be reflected in human action.

MR. T. SMITH remarked that there must be hundreds of thousands of people who had no proper accommodation in which to listen in. During the previous week there had been a gramophone concert given in Whitechapel by the H.M.V. Company which had lasted over two hours and at which 2,500 people attended. Was it not possible for the B.B.C. to broadcast operas under similar conditions, and also to provide someone to explain the opera? Was it not perhaps a fallacy to broadcast in the elementary schools during school hours? Did it not weaken the position and prestige of the teacher after the children had heard a specialist? Had not broadcasting also reduced the number of children who were taking up the cultivation of music personally?

MR. T. MAYNARD TIPFIELD, referring to one of the last speaker's points, thought teachers would rise still higher in the estimation of the school children, by being able to add to and supplement broadcast lectures. He was convinced that broadcast lessons were extremely beneficial to the school children.

MR. VAL A. BELL also felt that the teachers' prestige was not going to suffer by broadcast lectures. In fact, he had heard one youngster say, after hearing a loud-speaker: "If our teacher talked like that we would throw tomatoes at him." Certain lectures could be of enormous benefit to the scholars. As Educa-

tional Adviser at Wandsworth Prison, he testified to the great benefit of wireless. He had been surprised to get requests from many men there that certain books, of which they had heard over the wireless, should be put into the library for their use.

Miss C. Cook (Mass., U.S.A.) thought the lecturer would agree with her that the further away we got from general recreational broadcasting towards the more educational type of broadcasting, the nearer we came to a very dangerous line of distinction between what was education and what was propaganda. She would like to know how the scientific, unbiased character of the broadcasting such as Mr. Fletcher had described was to be guaranteed.

MR. GEORGE FLETCHER thought that perhaps Captain Eckersley had produced a wrong impression upon the audience. It would be absurd to suppose that Captain Eckersley was not enthusiastic in the matter of educational broadcasting. Captain Eckersley believed in the great cultural value of broadcasting, and in a broad cultural education; he only objected to the labelling of that as "education." There was an absence of any reference in the paper to one matter which lay very close to his own heart and conscience. He had spent part of his life in teaching and in administering education in remote rural districts. This country still had before it the problem of keeping people on the land and retarding the influx of people from the land to the large towns, already too crowded. Yet he had to declare that if he had to live, especially in winter, under conditions which characterised many of the rural districts of these islands, he should long for the glare of the city and the jazz band. It did not follow that one should seek to give to the people in remote rural areas—indeed, it would be a shocking abuse of our responsibilities to do so—the glare of the city and the jazz band even if it were possible. The problem now, as always, was how to improve the amenities of the countryside and to facilitate cultural influences which need not be labelled "Education"—and in such work broadcasting was an agent of the first importance. He remembered discussing this problem with members of the United States Government twenty-three years ago, who had the same problem to face—that of keeping people on the land. At that time the authorities sought to introduce the telephone into most out-of-the-way rural districts in order to give the people there a little of social contact. Every rural district in this country should have a village hall in which there was a receiving apparatus. He hoped by the alternative system, to which Captain Eckersley had referred, a programme would be issued which would give such people both amusement and education; he was convinced that there were many people in rural districts who would much prefer the latter to a jazz band.

THE LECTURER, replying, said that they must not take Captain Eckersley too seriously—sometimes he (Captain Eckersley) was like the orator who said, "Before I begin to speak I want to say a few words." Captain Eckersley had said a few words—and the Lord had delivered him into his hand.

Captain Eckersley had no use for formal education—yet he spoke French fluently—more than a little German, and was a distinguished engineer. When they taught him these things did they call them by any other names? The B.B.C. did not lay emphasis on the intrinsic value of its broadcast educational matter—on the other hand, it did not insult the intelligence of its listeners by wrapping up what was instructive and interesting like some sort of sugar-coated pill.

If there were people who supposed that because a talk was instructive was educative—it was therefore boring, then perhaps the B.B.C. might be the means of demonstrating to them that it was not so, and might cultivate a taste for deeper enquiry into matters worthy of serious study. It was at that that they aimed.

Besides, the B.B.C. did not force education upon people—no one was under compulsion to listen—there were alternative programmes. But there were many people who wanted to learn, as was shown by the sale of educational text books.

Referring to Miss Cook's remarks, Mr. Fletcher went on to say that it was not a question of getting away from recreational broadcasting down to broadcasting which was labelled "education" as such. Nobody could seriously consider the problems which faced this country to-day and honestly say that one could teach people the things they had to get to know in order to live and move in this world and yet pretend that it was anything else but education. Why try to get away from the fact? The B.B.C. recognised the importance of guaranteeing the "scientific" unbiassed character of the educational matter broadcast. They had set up two Central Councils representative of all the prominent authorities concerned, and the teaching profession itself was well represented.

He did not think that broadcast lectures would weaken the position of the teacher. The best guarantee of that was what the teachers themselves said, and in this connection he drew the attention of the audience to what the head of a men's evening institute in the East End of London had said: "You are doing one very important thing for us. You are putting us in touch with first-class scholarship and opinion, thus invigorating us, and particularly me, in our efforts. The danger of all schools and ours is a school, of course—is dust, mental dust. You are throwing open the windows for us and giving us draughts of fresh air."

Sir Richard Gregory had touched on a point which he would like to have elaborated, namely, the vital importance of broadcast matter in stimulating further interest and study. If that was not the beginning and end of what the Corporation was trying to do, it was something very like it. They were trying to do two things. They were trying to bring fresh voices into schools, and they were trying also to stimulate an interest in subjects which the average individual could not get in the environment in which he or she was ordinarily placed.

A hearty vote of thanks to the lecturer concluded the meeting.

NOTES ON BOOKS.

— ◆ —
PRACTICAL COLOR PHOTOGRAPHY. By E. J. Wall, F.C.S., F.R.P.S. London: Chapman & Hall, Ltd. 15s. net.

This is the second edition of an American manual which has been in wide use since its first appearance in 1922. While the theoretical side of the subject is somewhat meagrely treated, the practical details are particularly full and intelligible, and include summarised working instructions for almost every known process of colour photography.

The paucity of systematic explanation of the principles on which the various methods are based, while resulting from the author's deliberate decision, is nevertheless to be deplored. Not only is a clear general view of the subject thereby rendered unnecessarily difficult to obtain, but even the most practical instructions are much harder to grasp when their ultimate purpose is obscure.

Excluding one or two interesting but quite unpractical processes, it may be explained that the "colours" in a colour photograph consist of dye-stuffs suitably disposed; the problem being so to arrange matters that these dyes are laid down in the final transparency or print in such a manner as to produce, to the eye of an observer, a chromatic effect comparable with that of the original object. Technical imperfections apart, this can in theory be effected by the use of only three different dyes. It is true that the resulting colours may be very different in physical constitution from the originals, and that a spectroscope might not be deceived for an instant by the imposition; but the eye is not a spectroscope, and all that is necessary is that it should be suitably stimulated.

The practical processes in use for building up the final picture fall into two fundamentally different classes, the subtractive and the additive. In the former, the picture consists of three superposed transparencies, each transparency being stained with one of the three dyes already referred to. White light traversing the combined picture was to run the gauntlet, so to speak, of all three dyes in varying depths of intensity; at each film it will lose some of its original colours, and its final hue, as it reaches the eye, will thus be determined by the relative densities of the three coloured films it has traversed.

The additive process is very different. Here, as a general rule, we produce a mosaic of very minute spots, each spot being stained by one only of the three dyes; so that from any small area of the picture the eye receives a group of minute light-pencils of the three colours in question. Which will predominate, however, will obviously depend on the relative numbers of the differently coloured spots in the area; and since the spots are far too small to be visible individually, it is evident that a blending will occur in the eye, and that any desired hue can be given to the area by proper adjustment of these relative numbers.

An important theoretical difference between the two classes is that in viewing a subtractive picture one sees light which has passed through three coloured films in succession; whereas in an additive picture all the coloured grains of the mosaic lie side by side, and no pencil of light has to penetrate more than one. It is not difficult, therefore, to imagine that the three stains used in the first process have to be totally different in colour from those used in the second, if similar chromatic effects are ultimately to be produced.

The author begins with methods founded on the subtractive principle, and describes how the process starts with the production of three negatives, taken through three differently coloured screens. The exposures may be made simultaneously, using a single lens, in a special camera; or successively, using an ordinary camera; or again one may use a "tri-pack," which consists essentially of a pack of three films, practically in contact, of differing colour-sensitiveness, and separated by colour-screens.

Next are described the great variety of processes by which the coloured transparencies are produced from the three respective negatives, full practical details being given in almost every case. Though these details differ very widely, the methods approximate in principle either to the gum-bichromate or to the carbon process, as used in monochrome photography.

Turning to the additive processes, we find that these are represented almost entirely by the so-called "screen-plates," of which the best-known example is the Autochrome. The mosaic, to which reference has already been made, is produced in several different ways. In the Autochrome, brightly-dyed starch grains, of three different colours, are mixed in such proportions as to form an apparently colourless heap, which is then spread over the film in a layer one grain thick; in other

screen-plates, a coloured geometrical pattern of minute spots is printed mechanically. It is to be noted, as an interesting feature of screen-plates, that the coloured light-filters, through which the emulsion is exposed, are thus the actual spots of colour which compose the final picture.

The author does not confine himself to methods which are commercially practicable; and some of his most interesting chapters deal with so-called "laboratory processes" which can never come into popular use. Included in this group is the beautiful device of Lippmann, in which the colours are produced by optical interference or diffraction.

A final chapter is devoted to cinematography in colour. Although this problem presents difficulties of its own, it opens up the possibility of two additive processes, both differing essentially from anything so far described. In one of these, three images of different colour are projected simultaneously, through three lenses, on to the same screen; in the other, which also fulfils the additive condition, though in a peculiar manner, red, green and blue-violet pictures are projected in regular rotation. Each image, of course, persists long enough on the retina to be blended with its successors in the familiar cinematographic fashion, and the effect produced is one of normal colour. This particular method, however, amongst other disadvantages, has that of frequently producing severe headache in the observer; and since all the alternative processes suffer from defects and difficulties of one kind or another, the author is certainly justified in remarking that "cinematography in colours is hardly within the purview of the average amateur."

A HISTORY OF BRITISH WATER COLOUR PAINTING. By H. M. Cundall. London. B. T. Batsford, Ltd. 25s. net.

Holbein introduced the miniature into this country, and a Fleming, Wyngaerde, familiarised our artists and patrons with the tinted topographical drawing. More important was the influence of Wenceslas Hollar in the seventeenth century. Hollar was brought over by that famous Earl of Arundel to whom Van Dyke owed so much, and of whom Rubens painted the admirable portrait that is in the National Gallery.

It was a long time before landscape painting in water-colour broke away from the topographical tradition. The old technique was admirably used by Rowlandson for caricature, and the new technique foreshadowed in the work of Alexander Cozens and Paul Sandby, rival candidates for the title of "father" of English water colour. Angelica Kauffmann, too, though principally a painter in oils, did interesting drawings in wash.

Richard Wilson and Gainsborough struck the fetters from the art of water-colour. Their followers, in the more restricted sphere, were J. R. Cozens and Thomas Girtin, who, contenting themselves with a relatively narrow scale of colours, cultivated a modest naturalistic manner. Turner was more ambitious, and showed no less dash in water-colour than in oils. His extraordinary evolution of style is demonstrated by three plates in Mr. Cundall's book, of which this is the second edition, revised and enlarged. Waltham Cross, plate XII, illustrates the early phase, in which Turner's colours were sober and his designs often excellent. Hastings, plate XIII, belongs to his middle period, and bears a strong resemblance to his animated sea-pieces in oil in the National Gallery. The Lake of Thun, plate XIV, has the interesting but exasperating characteristics of the famous Petworth Interior.

At any rate, here we have the possibilities of water-colour at last properly explored.

Henceforward every painter who had individuality managed to express his personal vision in this medium. Mr. Gulland's selection of plates could hardly be better for illustrating the point. In water-colour as in oil the nineteenth century painters formulated their mysticism, romanticism, sentimentality; their scientific dogmas, their faith in æsthetic or non-æsthetic principles. From Constable and Samuel Palmer to Whistler, *via* the Pre-Raphaelite Brotherhood, the record is complete. On the whole one feels that the weaker the artist the more he is exposed by his work in water-colour, and the stronger he is, the more interesting is the analysis of his method afforded by his experiments with the less noble medium.

The author concludes with a chapter on the New English Art Club. The short biographies of artists are valuable; and it need hardly be said that Messrs. Batsford have produced the book in a worthy manner.

SPANISH GARDENS. By C. M. Villiers-Stuart. London: B. T. Batsford, Ltd. 25s. net.

There are three sorts of ideal garden, and all three types have their charm. In the Gothic or sentimental ideal, the garden appears to have grown up naturally, without human intervention; even the honeysuckle looks as if it had enlaced the old cottage spontaneously. In the classical ideal, the formal garden is a middle term between architecture and free nature: it compromises between the exact design of the house and the indiscipline of the fields and woods. In the Iberian ideal, house and garden are one. There is one word, *carmen*, for the two together. They are designed simultaneously, and are interdependent.

The Moorish princes whose dazzling *regime* was overthrown by Ferdinand and Isabella were passionately fond of gardens; to this day Spain adheres to their system of planting. The Moslem had a leaning for geometric pattern which corrected or strengthened his love of the luxurious and the exotic. But the baroque, whether house or garden, has always been spiritually at home in Spain; the Egypto-Byzantine baroque of the Ommeyyads; the Gothic-Burgundian baroque, or Mudejar, of the Catholic Monarchs; the Italian baroque of the Renaissance, in which all Spain was rebuilt. For this reason, while giving the Moors full credit for their actual achievement, we must not make too much of their influence; we must acknowledge a debt to the sun and the soil.

Nevertheless, more than half of Mrs. Villiers-Stuart's book is devoted to Moorish gardens and sites; and half is not too much. The grand manner of the Moors was based on a foundation that is next best to intelligent humanism: on a coherent cosmogony. The paradise-garden was the earthly replica of Paradise itself. Just as we are given to understand that there are seven chambers in Heaven, so do we learn that in the Moslem Paradise there are eight Pearl Pavilions: hence the eight glorietas in the gardens of the Alcazar, and the glorietta system generally.

But no antithesis need be sought none will be found between classical humanism and the spirit of the Spanish gardens. What distinction there is, so far as expression is concerned, is one of degree. The gardens were to be comfortable, interesting and beautiful. The garden architect's patron, it was borne in mind, was neither a god nor a machine, but a man of sensibility and sophistication.

Look at plate LIV: La Granja de Fortuny. Who would not sooner retire to this lovely spot than to one of the dehumanised villas of the machine age? The garden follows an ancient Moorish plan, and with its waterfalls and terraces of orange groves is an exquisite example of that romantic type of design that is only carried out when man and nature are in perfect collaboration

P.B.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4001.

VOL. LXXVII.

FRIDAY, JULY 26th, 1929.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.(2)

NOTICE.

COMPETITION OF INDUSTRIAL DESIGNS.

A selection of the Designs received in the above Competition for Prizes and Scholarships offered by the Society and well-known manufacturers will be exhibited, by kind permission of the Board of Governors, in the Exhibition Pavilion of the Imperial Institute, South Kensington, from the 3rd of August to the 1st of September next, every weekday from 10 a.m. to 5 p.m. (Sundays 2.30 to 6 p.m.)

The Exhibition is open free of charge; no tickets are required. It will include Designs for Architectural Decoration, Textiles, Furniture, Printing and Book Production, Pottery and Glass, and for Posters, Showcards, etc.

Several important firms have expressed a wish to offer Prizes for Designs in connexion with the 1930 Competition.

A Bureau of Information has been established at the Royal Society of Arts in connexion with the Competition, for the registration of the names and addresses of exhibitors who desire to obtain employment as designers. These lists are at the service of manufacturers in search of designers.

A report on the competition, including full lists of awards, will be published in the *Journal* at a later date.

REPRINT OF CANTOR LECTURES.

The three Cantor Lectures on "Biology and Refrigeration" by Dr Franklin Kidd, M.A., D.Sc., recently published in the *Journal*, have been reprinted in pamphlet form (price 2s. 6d.) and can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, W.C. 2.

A complete list of Cantor, Howard and other lectures, which are available in pamphlet form, can also be had on application.

PROCEEDINGS OF THE SOCIETY.

SEVENTEENTH ORDINARY MEETING.

WEDNESDAY, APRIL 10TH, 1929.

SIR RICHARD A. S. PAGET, Bart., in the Chair.

The following paper was read :—

SOME MODERN ASPECTS OF ELECTRICAL COMMUNICATION.

ADVANCES IN TELEGRAPHY AND TELEPHONY.

By G. H. NASH,

European Chief Engineer, International Standard Electric Corporation.

In order that some of the more modern aspects of electrical communication may be followed with clarity, it will be desirable first of all to take a broad view of the major elements that enter into the modern telephone or telegraph communication system, but before taking this broad view it may be well to remind ourselves that this lecture before the Royal Society of Arts is only one of many previously delivered in this building

The Royal Society of Arts has encouraged electrical communication from its earliest stages, and as long ago as 1856 the word "telephony" appeared in the *Journal* of the Society, when it was applied to a method of transmitting musical sounds. One of the most important contributions to the subject in the *Journal* was the account on November 30th, 1877, by Professor A. Graham Bell himself, of the articulating telephone, on which occasion the harmonic character of alternating currents was for the first time revealed and recognised. Also, in many lectures particular aspects of communication by wire have been dealt with; amongst others I would mention submarine telegraphy, the Hughes type-printing telegraph, and the D'Arllincourt method of transmitting writing

Agaif, in successive Cantor Lectures, the story of Hertzian wave telegraphy has been told, and one of the most recent lectures on this subject was that given by Senator Marconi, when he described the results of his experiments with Beam Transmission.

The purpose of the present lecture is to discuss some of the lesser known problems which arise on very long distance telephone connections, and to explain how, by modern methods of telegraphy and telephony, a number of communications can be made simultaneously over a single pair of wires without interference. Therefore, for the purpose, I have had prepared a diagram

(Fig. 1) which shows the main links in a long telephone connection between two subscribers over two continents and including a transoceanic radio link, and I will describe briefly the various stages of such a connection, and, in passing over them, refer in some cases to recent improvements.

The diagram, as you observe, shows the complete connection from telephone subscriber to telephone subscriber in which is included, first the private branch exchange, then the automatic exchange, then the trunk exchange, then the two-way repeater on the trunk line, then the distant trunk exchange, then the technical operator's position controlling a wireless link, and so on through a similar train to the distant subscriber.

Reviewing this diagram step by step, it may be advisable first to say a few words about the subscriber's set which, extraordinary as it may sound, has not received its fair proportion of scientific thought and investigation when compared with practically all the other equipment shown on this diagram.

The subscriber's set, as the sensory organ of the telephone system responding to the sound waves emitted by the speaker and ultimately converting the received electrical currents into sound waves by means of the receiver, is one of the most important parts of a telephone connection ; since there is no change quite so radical as the conversion of sound energy into electrical energy, and *vice versa*, for no telephone system can be possible without the means of doing this.

The subscriber's set has, however, to do a good deal more than act as the speech and hearing organ of the telephone system ; it has also to act as the nervous system, inasmuch as it calls attention by the ringing of the bell to an incoming call, and it attracts the attention of the exchange operator when an outgoing call has to be made. Still more than this, in the case of a set connected to an automatic exchange, the dial by the manipulation of which the complete automatic connection is set up may be regarded as equivalent to the motor centres of the brain. All these functions have to be performed by the ordinary telephone user, and everything must, therefore, be simple, so that there may be no difficulty or confusion arising when an individual uses the telephone rarely, or even for the first time ; in other words, the telephone system has to be placed within the reach and control of the subscriber, it has to be operated (in the case of automatic telephones) by the subscriber, and yet with such simplicity that it is kept in operation in spite of the subscriber.

The model on the table illustrates a modern telephone subscriber's set. The hand-set, or telephone instrument proper, will be recognised at once as being more convenient and comfortable to use than the pedestal-type telephone which has been in use in this country hitherto, although the pedestal instrument was reliable and efficient.

There have been many difficulties to overcome in producing hand-sets which would give the same degree of reliability of service as can be obtained from the pedestal type of set. These difficulties have arisen mainly from the fact

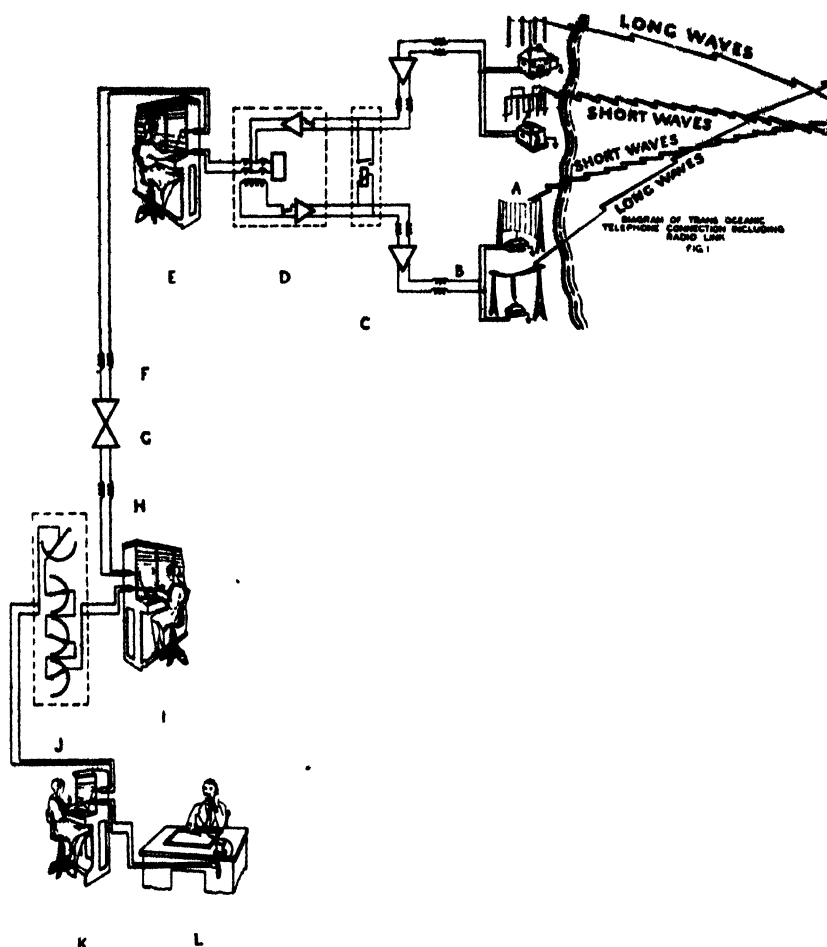


Fig. 1—A, Radio Stations, B, One-way Amplifier, C, Two-way Repeater, D, Long-distance Trunk Exchange, E, Loading Coil, F, Two-way Repeater, G, Local Private Branch Exchange, H, Subscriber, I, Subscriber, J, Subscriber, K, Subscriber, L, Subscriber

that in a combined instrument of this type the talking distance of the mouth from the mouthpiece is determined by the size of the speaker's head, since it will readily be realised that the telephone must be placed on the ear and, consequently, the mouth cannot, as a rule, be approached closely to the transmitter; this has made it difficult to secure adequately loud speech in all cases. The other main source of difficulty has been intimately associated with the one particular characteristic advantage of hand-sets; that is to say,

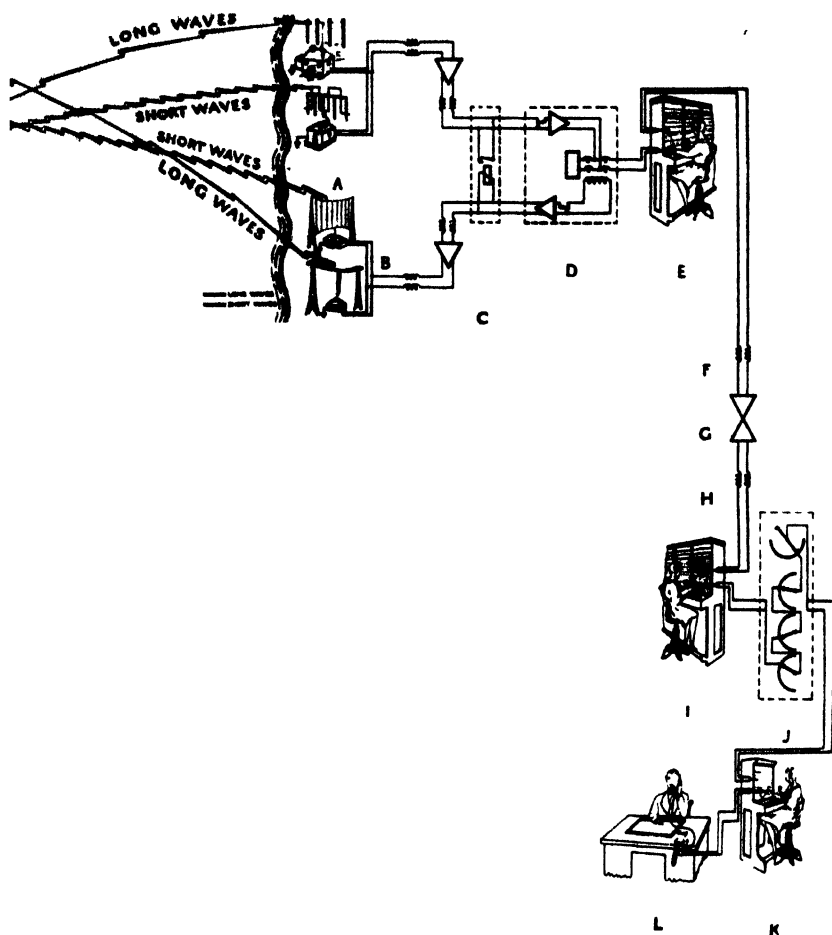


FIG 1.—C, Echo Suppressor, D, Technical Operator's position, H, Loading Coil, I, Local Trunk Exchange, J, Local Automatic Exchange

the entire freedom of movement which the user enjoys enabling him, for example, to lean back in his chair in a comfortable position rather than to sit up stiffly in front of the fixed transmitter; thereby it has been necessary to find a transmitter capable of functioning in almost any position, and this has been surprisingly difficult as will, perhaps, be understood when one considers that the transmitter contains loose granular powder between electrodes, and that it is essential for the operation of the apparatus that the powder should be loosely distributed and not packed tight.

Passing from the hand-set the call passes through a private branch exchange which is probably familiar to most of you and, in any case, involves no particularly new feature, and from thence to an automatic system. A model will be demonstrated after the lecture of an automatic system which is somewhat similar to the type of automatic system being installed in this country by the Post Office.

The means by which the subscriber obtains the attention of another consists in the main of an electro-magnetically controlled mechanism known as the "Selector." This mechanism has associated with it an electrical circuit containing relays and electro-magnets, and is capable under the direction of electrical impulses of stepping its shaft both vertically and horizontally, and also effecting a release to normal. Normally the mechanism is arranged for ten steps in each direction.

If, then, there is attached to the shaft an arm with a wiper, it is possible for this arm to be directed to any point in a field or bank of 100 contacts arranged in arc corresponding to the rotary sweep of the wiper. This is the simple case of the Step-by-Step System, and would enable a subscriber connected to the wiper to reach any of 99 other subscribers.

In practice a subscriber is given a dial which is capable of being rotated to the required number and on its return journey interrupts the circuit, thereby supplying impulses to the selector. Two operations of the dial are necessary to give the selector vertical and then rotary motion to the required line

To enable any subscriber to call another in the 100 line case, it is clear that each would require a selector, an obviously impossible economic scheme. Selectors are only provided in practice to cater for the greatest probable number of simultaneous conversations; hence the number of selectors is much less than 100. In order to connect 100 subscribers to a less number of switches, each subscriber has a rotary line-switch which has wired to its arc, trunks to each selector. When a subscriber removes his receiver, the line switch instantly hunts for a free trunk and the subscriber proceeds to dial his two digits into the selector, which connects him to the required party and applies ringing to his line. After conversation the line switch and selector return to normal.

From the automatic exchange we will pass to a trunk exchange.

The operating procedure with long-distance traffic which is handled at the trunk exchange, differs considerably from that at local manual exchanges. Long trunk lines are very expensive, and, except when long distance telephony is well developed, it is not economically possible to provide sufficient lines so that subscribers requiring a long distant call can be connected without delay—at least during the busy day period. Service is provided on what is termed a delay basis, the delay depending upon the number of calls waiting for a free line. Calls to the trunk exchange must therefore be recorded and the tickets given to an operator who takes each in rotation as the trunk line is free.

The trunk exchange, therefore, is provided with a recording switchboard

where the operators receive the request for a call from the subscriber *via* his local exchange, note the details on a ticket and advise the subscriber that he will be called when the connection has been set up. Special arrangements have to be made to distribute the tickets to the trunk line operators, and it is the duty of a distributing operator, who knows the positions dealing with a particular trunk line, to forward these tickets. When the distributing operator's positions are in the same line as the recording switchboard a very satisfactory and largely-used method of conveying the tickets from the record position to the distributing operator is by means of a belt conveyor.

At the distributing position the tickets are sorted and sent to the particular trunk line position concerned. Some form of pneumatic tube equipment is usually provided for this purpose. The distributing operator is provided with a series of sending valves connected to tubes ending in receiving valves at the various trunk operators. The ticket is inserted in the appropriate sending valve and delivered to the line operator, where it is placed in order of its priority. Each trunk line operator has also a sending valve connected with a tube to the distributing operator, so that when the call has been completed the operator may return the ticket to be marked with the appropriate charge, then sorted and filed ready for the account to be made up.

The return tubes from the line positions are usually common to a line of switchboards and end in a receiving valve at the distributing position. For the system shown the tickets are delivered under pressure from the distributing position to the line position, and by means of suction from the line position to the distributing and filing position.

It will be appreciated also that it may be necessary to connect together two trunk lines at a trunk exchange. Special positions are provided for this purpose, and if an incoming call is received for connection to another trunk line, arrangements are provided for transferring the call to the special through position. It is often necessary when two trunk lines are connected at a through position, to insert a repeater in the circuit so that speech will be audible over the whole circuit. For this purpose there are provided cord circuits with repeater equipment connected thereto, so that any two lines may be connected together through a repeater. Such an equipment is known as a cord circuit repeater.

Where long-distance telephony is more highly developed a sufficient number of lines can be provided to supply a no-delay service. The recording switchboard is then abandoned and a method of operation known as the combined line and recording method is introduced. In this method the trunk line operator receives the call from the subscriber and makes out the ticket, but the subscriber does not hang up and wait to be called. Instead, the line operator completes the call to the required subscriber and connects the two together with little or no delay. The ticket is then stamped in the usual way. This saves recording

positions and a good deal of ticket distributing equipment, and gives, of course, a much faster service.

Where trunk exchanges are used in automatic areas the trunk line positions are often fitted with a dial for automatically connecting to the required local subscriber. In some modern trunk exchanges also automatic equipment is used extensively for inter-connecting between different positions and also for automatically distributing incoming calls to the recording position. Here the operator has merely to operate a key to be put in connection with a calling subscriber and takes the particulars of his call.

If the calls, instead of going to the distant trunk exchange and so on to the local subscriber, have to pass through a radio link, these calls are passed to a special position equipped with the necessary apparatus for the purpose and operated by a technical control operator. For the purpose of the lecture however, it will be assumed that a radio link is involved. As is well known, the Atlantic radio link operating between this country and America is the only official channel for telephone communications existing between the old and the new world.

The Rugby Radio Station is situated about 4 miles south-east of Rugby and occupies a site about $1\frac{1}{2}$ miles long by 1 mile wide.

The station buildings are erected at about the middle of the site. These buildings also accommodate the high power telegraph transmitter used for the Imperial Wireless Service. The aerial is supported on twelve masts, each 820 feet high, and is so arranged that it may be divided into two sections. The telephone transmitter uses one section only.

The masts are insulated at the base. Twelve columns of porcelain insulators are placed immediately below the pivoted joint of the mast, the whole being supported by a granite block and a steel column. The mast can be raised by hydraulic jacks in case it is necessary to replace any faulty or damaged insulators.

The transmitting equipment can be divided broadly into four parts, namely, the low power or "sideband" equipment which produces the single sideband of radio frequency, the power amplifier which amplifies this to the value required for transmission across the Atlantic, the output tuning circuits, and the control table.

The sideband equipment comprises apparatus for controlling and amplifying the voice currents received from the telephone line, oscillators and modulating apparatus which convert these voice currents into a single sideband of radio frequency and the first stages of amplification necessary for amplifying the latter up to a power level of about 50 watts. The above apparatus is mounted on four panels installed in a special room entirely shielded with copper gauze.

There is a control table from which position the operator on duty is able to control the whole station. Behind the control table are two power amplifier units, each consisting of fifteen water-cooled valves. This is the final stage of

amplification capable of delivering an output of 300 K.W., which is equivalent to 400 h.p. Two earlier stages of amplification, the first employing one water-cooled valve and the second employing three water-cooled valves, raise the output from the sideband equipment to the power level required for driving the final amplifier.

The receiving station on this side of the Transatlantic Radio Link is installed near Cupar, in Fifeshire. Two receiving sets are in operation

Directive reception is employed in order to eliminate unwanted signals. The system used consists of six large loops each of them supported on two 130-ft. steel towers placed 200 yards apart. The loops are situated at distances up to three miles from the receiving station. By correctly placing the six loop systems and combining their outputs very few signals are received from any direction other than from Rocky Point.

As a supplement to the long wave Transatlantic Link a short wave circuit is now in operation, so that two circuits are available during most hours of the day. The short wave transmitter at present in use at Rugby is an experimental set.

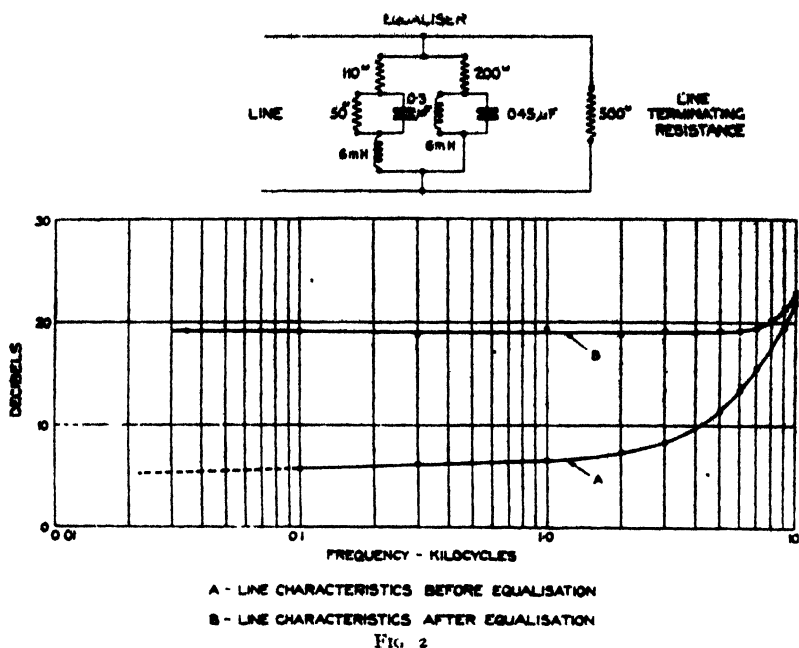
From the transmitting station we pass by means of wireless waves to the receiving station on the other side of the ocean and from this stage the various links are identical in nature with those already described.

Now, very long distance telephone connections of this kind, or similar connections which may only involve aerial and cable circuits exhibit certain effects (which are present to a negligible degree in shorter circuits) and special steps have to be taken to mitigate them. These effects are :—

- (a) Attenuation distortion
- (b) Phase distortion
- (c) Echoes
- (d) Interference

(a) *Attenuation distortion* sometimes called frequency distortion, refers to the variation of the attenuation or power efficiency with frequency. An unloaded cable is a prolific source of such distortion, the attenuation increasing rapidly with frequency. The method of loading cables, commonly practiced, by the insertion of lumped inductances at intervals of about six thousand feet, causes the attenuation to remain relatively low over the most important part of the speech range, after which it rises to a value higher than in the absence of the loading. This results in a reduction of distortion over the essential part of the speech range, but in certain cases the residual distortion may still be intolerable.

Attenuation distortion may be removed by the association of suitable resistance—reactance networks with the circuit; these are usually referred to as attenuation equalisers and introduce loss at the frequencies where the line loss is low so that the sum of the line and equaliser loss approximates to a constant value for all frequencies transmitted. In certain cases the



reactances and capacities associated with the transformers of the amplifier constituting part of a telephone repeater may be adapted to supply the necessary equalisation, this method has found favour in toll cable practice on account of its obvious economy.

Long distance circuits are of course not exclusively confined to the transmission of speech, and may be used for broadcasting or other purposes such as picture transmission.

As an example of the ease with which equalisation can be carried out over a comparatively wide frequency range, Fig. 2 shows the measured attenuation of a special broadcasting circuit before and after equalisation, together with the equaliser which was used for the necessary compensation

(b) *Phase distortion* is introduced by the difference in time of travel for different frequencies; it derives its name from the fact that the time of travel depends upon the way in which the phase shift of the complete system varies with frequency. The statement by Helmholtz that relative phase shift of different frequencies is not important applies only to steady tones and breaks down when the conditions are so extreme that parts of a finite wave envelope starting at the same time arrive at the receiving end at different times, and when the difference in the time of arrival is greater than 30 milliseconds.

In practice, for long distances, loaded cables having a higher cut-off are

generally used so that phase distortion does not become serious until appreciably higher frequencies are reached and it is automatically eliminated by the fact that the repeaters normally used do not pass the frequency range above 2,400 cycles. For two wire circuits, high cut-off cables have the additional advantage that their speed of propagation is greater, which makes echoes less harmful, their impedance is more uniform within the pass range which facilitates the construction of balancing networks, and their attenuation distortion is so small that very little correction is necessary. As an alternative to the use of high cut off circuits the use of time delay correcting networks in an analogous manner to attenuation equalisers, has been proposed. These networks are either of the lattice or bridged T type, arranged so that they build up the time of travel of the fastest frequencies (*i.e.*, the low frequencies in this case) to be as nearly as possible equal to the time of travel of the slowest frequency in the pass range of the system.

(c) *Echoes* are caused either by the return of part of the speech energy to the talker after an odd number of reflections, or by subsequent repetitions of the speech arriving at the receiving end after an even number of reflections. The term "reflection" is here intended to include any event during the process of which the original speech currents give rise to currents having the direction of propagation reversed.

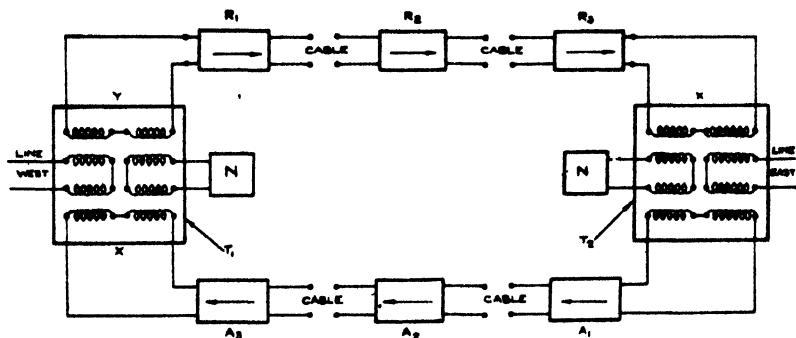


FIG. 3.

Fig. 3 shows a type of long distance circuit in which a separate pair of wires is provided for talking in each direction; this is usually referred to as a four-wire circuit. R_1, R_2 , etc., and A_1, A_2 , etc., are one-way amplifiers compensating for the attenuation in the associated cable lengths. T_1 and T_2 are terminating sets which behave effectively like Wheatstone Bridges, so that if the networks N balance exactly the impedance of the associated line, respectively west or east, then currents introduced at X produce no effect at Y , but only transmit speech out west or east, as the case may be. In practice, however, exact balance is never obtained, and a fraction of the current introduced at X appears

at Y and returns to the talker after one reflection attenuated by twice the equivalent of the circuit plus the loss across the terminating set. It returns to the listener after two reflections attenuated by three times the attenuation of the circuit and the sum of the losses through two terminating sets. In this way an indefinite number of separate echoes may arise, but subsequent repetitions in circuits having normal equivalents are so attenuated that considered individually they are not of serious practical importance.

In the case of a two-wire circuit each individual repeater has two balancing circuits associated with it, each of which affords the possibility of reflection taking place; but the reflection occurring at the terminals of the system is the most serious, because the balance there is always worse than at any other point in the circuit. This is on account of the fact that the end of the system has to be connected to a variety of circuits varying comparatively widely in impedance.

In order to eliminate terminal echoes it is usual to provide some means by which speech currents travelling through the circuit in one direction block the circuit operating in the other direction. This can evidently only be done at a point in the circuit where four-wire operation occurs. In the case of a two-wire system the circuit is in effect converted to a four-wire circuit at every repeater in order to permit the insertion of one-way amplifiers. For this reason, and because the highest levels are obtained in the output of repeaters, echo suppressors, whether of the relay type or grid-jamming type, are always associated with repeaters.

Fig. 4 shows a typical arrangement for echo suppression used by the International Standard Electric Corporation on four-wire systems. The top and bottom blocks may be considered to represent amplifiers occupying positions in a circuit similar to A, and R, in Fig. 3. The middle blocks constitute the echo suppressor, which exists in two halves identical in function and differing only in the arrangement of their filament circuits to afford the most economical disposition. Referring to the top half of the echo suppressor, valve 8 is an amplifier bridged across the output of the amplifier in line 2-2'. This valve applies the amplified speech voltages to the input of valve 10, which serves as a voltage limiter, and within the working range makes the behaviour of the apparatus substantially independent of speech level in the line. The output of the limiter is applied to valve 13, which rectifies the speech currents, causing a direct current to flow in resistance 14; within the operating range of speech levels, this current, owing to the effect of the voltage limiter, valve 10, is, to all practical intent, independent of the speech level at 2'. The voltage generated across resistance 14 applies such a negative voltage to the grid of the second valve that its amplification is converted into a loss.

In this way speech in line 2-2' paralyses the circuit 1-1', so that any echoes are rendered ineffective.

A special type of voice operated switching device is employed in connection

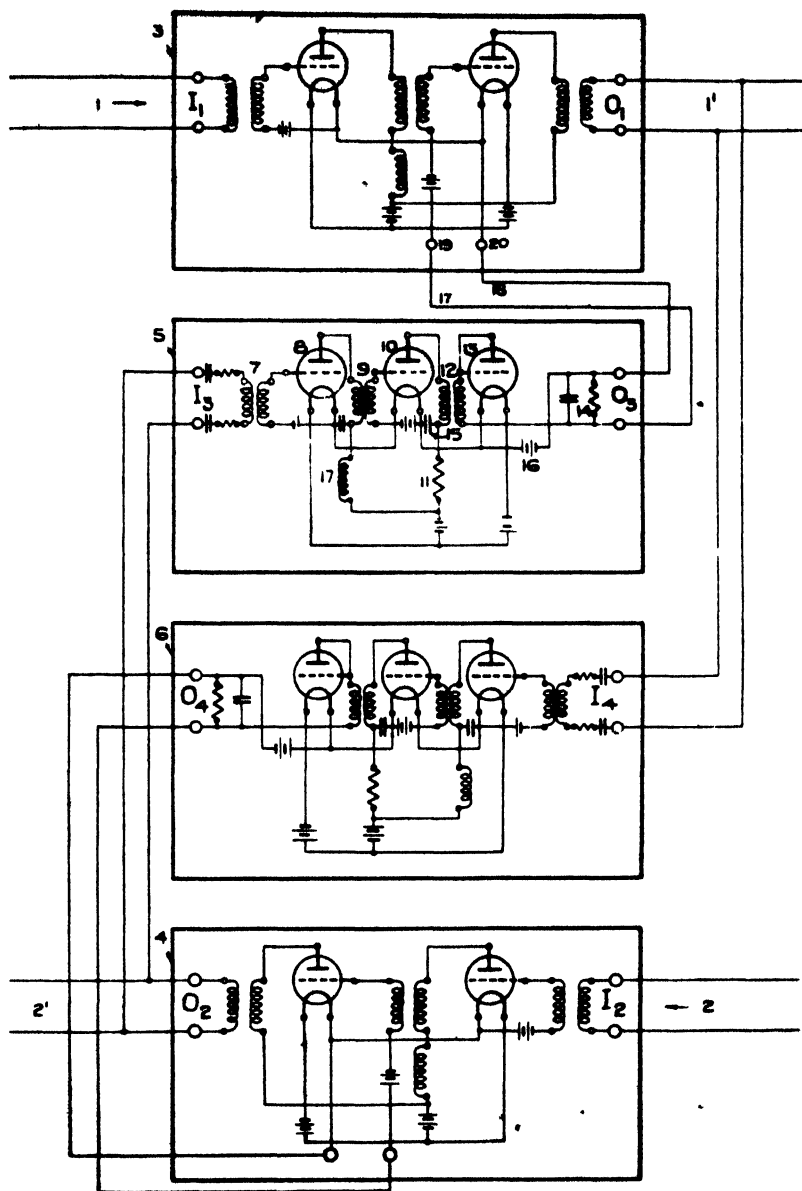


FIG. 4

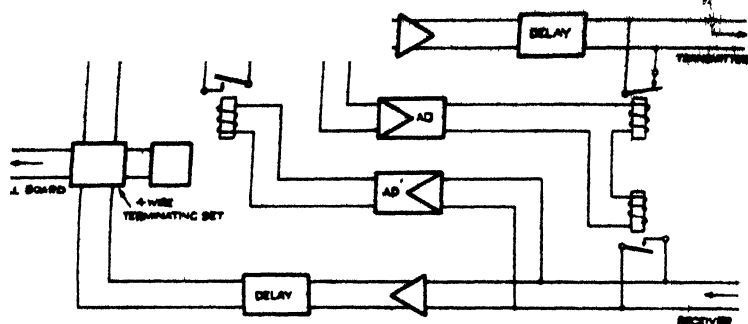


FIG. 5.

with the transatlantic circuit, which differs from a normal echo suppressor in that it is capable of suppressing an echo having a zero delay. This is made necessary because of the desirability of operating transmitting and receiving stations on the same wave lengths, so that the receiving system is capable of amplifying the relatively weak signals received from the distant station and yet rejects the much stronger signals received from the local transmitting station. For this purpose, to avoid clipping of the speech, it is necessary to introduce delay networks to retard the speech while switching operations are in progress. Referring to Fig. 5, the upper circuit carries outgoing speech to the radio transmitter and the lower speech circuit carries speech from the radio receiver to the subscriber. The receiving circuit is normally through and the transmitting circuit is normally blocked. Outgoing speech from the toll board arrives first of all at the amplifier detector bridged across the upper circuit and operates one relay which blocks the incoming circuit and another relay which removes the short circuit from the outgoing path. In this condition incoming speech or noise has no effect on the circuit.

On the cessation of outgoing speech the circuit returns to normal. Incoming speech blocks the outgoing circuit (close to the four-wire terminating set) and so prevents any unbalance currents passing the terminating set from operating the amplifier detector associated with the outgoing circuit.

In every case the delay network is of such a length that the switching processes are complete before the speech arrives at the output of the delay network.

(d) *Interference* in telephone circuits may be inductive or may be introduced by the charging and floating machines associated with the power plants of the amplifier stations, in the case of radio links the question of atmospherics has also to be considered. Inductive interference is introduced either by neighbouring power circuits, by telegraph circuits on the same route, or by speech circuits on the same route, in which case it is referred to as crosstalk.

Power induction is guarded against by careful survey of the route before

laying the cable, by suitable transpositions in the power lines themselves, by bonding on electrified railways, and by selective interconnection of the conductors of the cable at joints to balance the conductor capacities to earth.

Interference from power plants is reduced to a minimum by separating power supply circuits from speech circuits and by the insertion of filters in the power supply leads.

Reduction of telegraph interference is effected by the use of noise killers which are sometimes referred to as shaping circuits and which consist of low pass filters to suppress the high frequency components of the telegraph wave which are most serious in causing interference.

Crosstalk is reduced to a minimum by careful adjustment of the speech levels, by balancing the internal capacities in each quad, and by special attention to the inductance and resistance balances of loading coils, as well as by taking care to keep the conductor resistance of the cable itself balanced. Special care has to be taken in the layout of repeater stations and design of repeating coils, as well as in the arrangement of supply circuits, both low tension and high tension, since these are always common to a large number of repeaters.

The question of atmospheric interference has been left to the last, since it is a very special problem in itself. During certain periods of the day and year the interference by atmospherics, coupled with fading in the signal strength, is sufficient to render the circuit entirely inoperative. In order to reduce this inoperative period to a minimum special precautions are taken in the choice of wave lengths, in the location of the transmitting and receiving stations, in the type of antennæ, in the type of modulation process, and in the operation of the circuit, to ensure that the maximum ratio of signal to noise is always obtained. Generally speaking, it is always possible at any one time to choose such a wave length that satisfactory communication can be established, and this with a total use of only two or three wave lengths. The removal of the receiving station in England from Wroughton, Somersetshire, to Cupar, Scotland, was brought about purely on account of the better reception, and for the same reason the receiving station in America was located at Houlton, Maine.

Directional antennæ are used both for transmission and reception, and are an important factor in increasing signal strength and reducing noise. The single side band system of transmission in use at Rugby, in conjunction with complete carrier elimination, enables the highest degree of selectivity to be used in the receiving system, combined with a maximum radiation of energy at the frequencies carrying the speech characteristics. In the operation of the circuit precautions are taken to ensure that the radio-transmitter is always fully loaded irrespective of the strength of the speaker's voice, so that the maximum received field strength is always obtained.

The evolution of radio links has now reached such a stage that the terminals of such a connection can be regarded in exactly the same way as the terminals

of a land line connection, both from a technical and from an operating point of view. It is, of course, evident that, since radio links are usually costly, they should be operated on a similar basis to a high priced long distance circuit, with a maximum economy in line time. From a technical standpoint no point on the earth is so remote from another that it is impossible to connect the two by long distance telephone. Obvious economic limitations of supply and demand up to now have prevented the installation of many very long circuits. The circuit which was recently set up between Stockholm and New York is an example of the possibilities of long distance communication. This circuit was 22,264 kms. long, and was made up as follows :—

10,400 kms.	of extra light loaded cable
4,700 ..	radio link
6,850 ..	of open wire line
314 ..	of submarine cable.

It was equipped with 138 four-wire repeaters, 24 carrier repeaters, 6 cord circuit repeaters and 8 echo suppressors, including the special voice operated switching device at London and New York.

I now propose to deal with the number of communications possible over the same pair of wires at the same time and in considering any available telephone circuit of a type consisting either of aerial lines or short cable lines there is available for transmission purposes a frequency range extending from zero or a few cycles per second up to 30,000 cycles per second. Various communication systems have been designed to enable the maximum use to be made of this frequency range.

These systems comprise :—

- (1) The Composite Telegraph System, which is superimposed on the telephone system and occupies the frequency range from 0 to 80 cycles.
- (2) The Carrier Telegraph System, which occupies the frequency range from 3,000 to 10,000 cycles.
- (3) The Carrier Telephone System, which occupies the frequency range from 5,000 to 30,000 cycles.

The telephone channel is limited to the frequency range, 100–3,000 cycles, to permit the simultaneous use of one or more of the other communication systems

The Composite System on an open wire telephone circuit provides two independent earth return telegraph channels. The speed of transmission over each channel may be up to 25 cycles per second or approximately 60 words per minute Morse, and by the use of the ordinary telegraph duplex balance, the transmission may be in two directions simultaneously.

It will be evident that the use of telephone ringing current falling within the range 0 to 80 cycles will not be permissible over a composited circuit, since

it would interfere with the telegraph, and therefore it is necessary to insert special Composite Ringer apparatus, in the Exchange side of the line, repeating coils in all cases where the telephone signalling is by 16 cycle currents. The composite ringer translates the outgoing 16 cycle ringing current from the exchange to a higher frequency, usually 135 or 500 cycles, and transmits this over the line. Similarly it translates incoming calling signals from the line and transmits 16 cycle current to the exchange.

The Carrier Telegraph System provides 10 independent telegraph channels in both directions, each channel being capable of transmission at a telegraph speed of 40 cycles.

In carrier telegraphy the currents are more severely attenuated than in the case of direct current telegraphy, and carrier telegraph repeaters must be provided to compensate for the increased attenuation. These repeaters have been designed so that their spacing will correspond with the telephone repeater spacing on the line, and it is thus possible to accommodate the telegraph repeaters in buildings already housing telephone repeaters.

Carrier Telephone Systems provide one or three more channels over an open wire line or short underground or submarine cable which may be already in use for the usual purposes, *e.g.*, voice frequency telephony and composite telegraphy. From a trunk exchange operator's point of view there is no difference between a carrier circuit and any ordinary trunk circuit. The subscriber will notice only that the carrier circuit is free from the noise usually found on open wire trunk lines. The carrier equipment required can be classified roughly as carrier terminal equipment or carrier repeater equipment. At carrier terminals the speech frequencies received from a subscriber's set are used to modulate the carrier frequency. Modulation has the effect of converting the speech frequencies to higher frequencies, and it is these latter which are transmitted along the line. At the receiving terminal the high frequencies are "demodulated," or detected, and thus brought back to their true place in the frequency scale. By moving the frequencies resulting from several subscribers' lines to different parts of the frequency scale it is possible to provide several conversation channels on the same pair of wires. Separation between the frequencies resulting from the different conversations is effected by means of electric wave filters which are designed each to pass a band of frequencies and to eliminate all others.

Carrier repeaters are used on lines where the attenuation is too great to permit the use of terminals only. They have been designed so that their spacing corresponds with the usual spacing of voice frequency repeaters for the cause already mentioned.

Although it may be thought that carrier apparatus must be comparatively expensive, it is found in practice to be otherwise. In many cases, particularly for distances greater than 200 miles, it is cheaper to install and maintain carrier systems, than to provide and maintain additional pairs of wires to

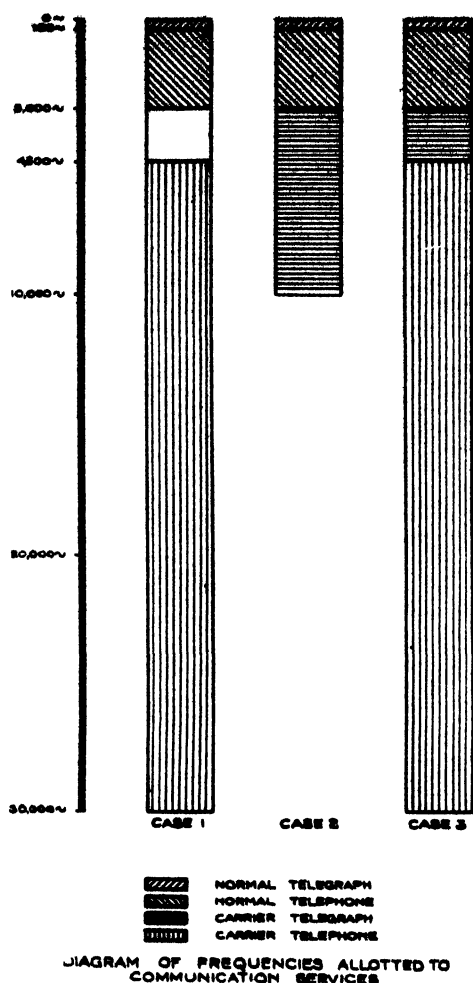


FIG. 6.

give the same facilities. Indeed, a single channel system has proved to be economical for distances as short as 40 or 50 miles.

The diagram Fig 6. indicates the frequency range occupied by the various systems, and Fig. 7 shows three alternative cases of their application to a telephone circuit.

In Case 1, Fig. 7, we have :—

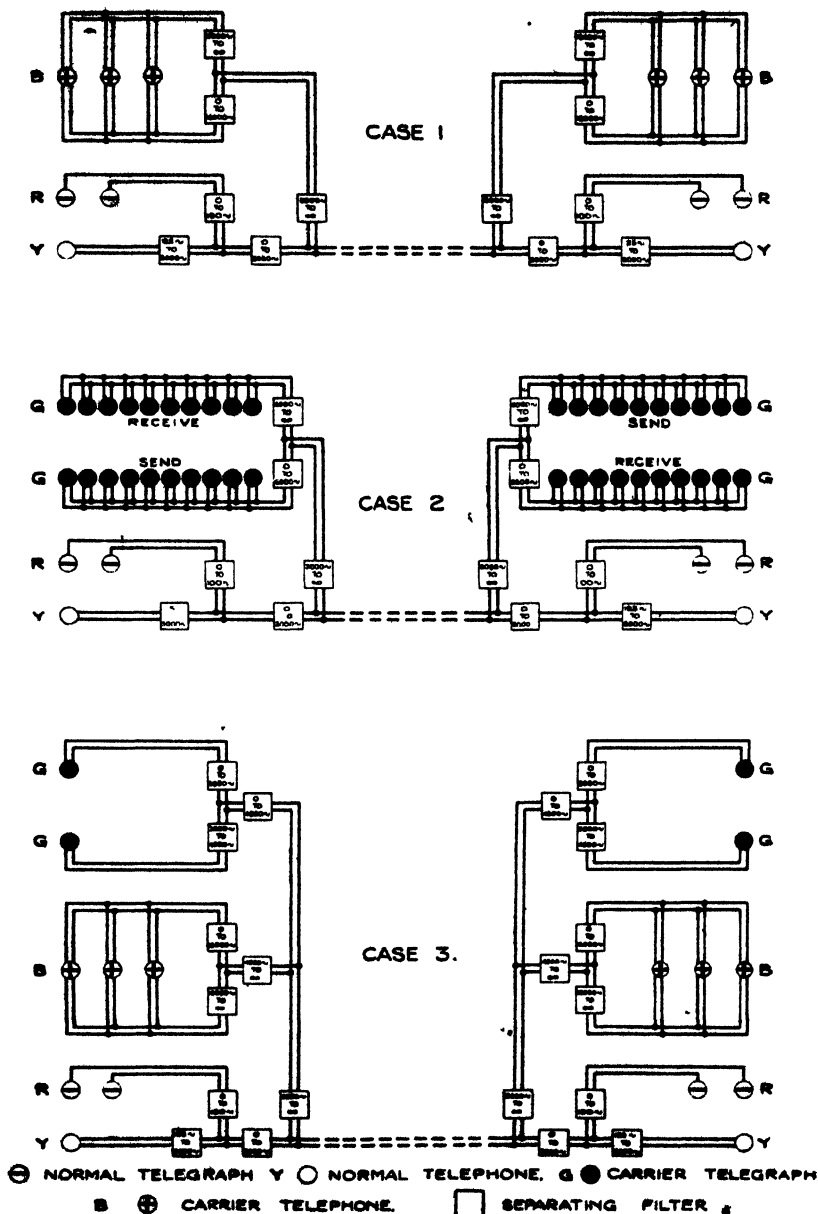


FIG. 7.

One normal telephone circuit
Two composite telegraph circuits
Three carrier telephone circuits

or a total of 4 telephone and 2 telegraph circuits.

In Case 2, Fig. 7, we have :—

One normal telephone circuit
Two composite telegraph circuits
Ten carrier telegraph circuits

or a total of one telephone and 12 telegraph circuits

In Case 3, Fig. 7, we have :—

One normal telephone circuit
Two composite telegraph circuits
Three carrier telephone circuits
Two carrier telegraph circuits,

or a total of 4 telephone circuits and 4 telegraph circuits ; this, I believe, represents the greatest amount of traffic that has been commercially carried, although I am aware that much greater capacities have been described in published papers, but not necessarily as actual accomplished results.

All telegraph circuits can be worked duplex.

In the first of these two cases the services can be operated at the same time without much difficulty, but in the third case careful consideration is necessary to ensure the location of the carrier telegraph channels in a range where they will not interfere or be interfered with by the carrier telephone channels, and it is probable that they will be restricted to the range 3,000 to 5,000 cycles or the range above 30,000 cycles. There is set up in this hall two terminal equipments connected by a pair of wires and equipped with ordinary telephone sets, two composite telegraph channels, one carrier telephone channel and one carrier telegraph channel, and by operating them all separately and then simultaneously but only receiving one at a time, their simultaneous operation without interference can be demonstrated.

DEMONSTRATION.

At the conclusion of the lecture the following experiments were carried out with the demonstration equipment :—

Conversation took place, or the telegraph apparatus was operated, on each channel of communication separately with all other channels silent. The loud speaker was connected in each case first to the mid point of the line, and then, in the case of the telephone circuits, to one of the terminals ; in the case of the telegraph circuits the operation at the terminal was observed, not on the loud speaker, but on the telegraph apparatus.

From these experiments could be judged the effect of the set of frequencies used for each channel as transmitted on the line.

The next stage was to have all channels operated simultaneously, the jumble of frequencies passing along the line being observed by connecting the loud speaker to the line.

To indicate that each of the channels was successfully separated from the others at the terminal equipment the final stage was to add the channels one by one to the line, to observe the effects on the line as each was added, by connecting the loud speaker to the line and then, by connecting the loud speaker to the terminal apparatus, to notice that each channel was functioning satisfactorily, as though the other channels were not in existence.

DISCUSSION.

THE CHAIRMAN, in opening the discussion, said the audience would wish to join in his appreciation of the extraordinarily interesting way in which Mr. Nash had described what was, he supposed, the most extraordinary thing which man had yet done on this planet. He doubted whether anybody had come across anything in which man had gone more completely beyond what would have been expected. That our tiny voice "that poor little noise we make every time we speak" should be capable of going 18,000 miles was extraordinary, and the fact that a single wire should be able to carry so many different messages at the same time was wonderful.

The thought which had kept coming into his mind as he had listened to the lecture had been how like it all was to what happened in our own brain. Neurologists said that the ordinary human brain had about as many separate living cells—neurons—as this world had inhabitants. That was to say, each of our brains had got about 1,400 million "inhabitants," and each of those "inhabitants" was on one telephone system—namely, the nerves. Many of those "inhabitants" had as many as ten different wires (nerves) leading to them. Therefore, each of us owned a very complicated telephone system, equivalent to the whole world on one telephone system. Mr. Nash and his friends and contemporaries were coming very near to that same sort of organism. He supposed it would not be very long before every inhabitant of this globe was on the telephone, and the interesting thing then was to think that the globe as a whole would behave as one individual. The next problem would be for that individual to find some other "individual" to talk to; otherwise life would be very dull!

There were many things he would like to say, but he would confine himself to expressing his personal appreciation for the immense amount of trouble to which Mr. Nash had gone in giving his demonstration.

MR. A. DAVIDSON (Vice-President, All-America Cables, Inc.), said that personally he had been interested all his life in submarine cables. Possibly, in the advance of research in connection with submarine cables, a great deal of the work which had been done on lines and circuits would find a place in the submarine cable. It seemed to him that communications of all kinds were coming closer and closer together. Nowadays we did not know where one began and where the other ended. He expressed his very hearty appreciation of the paper.

DR. F. J. W. WHIPPLE (Assistant Director, Meteorological Office), said he could find nothing but praise to give to such a delightful lecture as Mr. Nash had delivered.

Mr. Nash had a manner of delivery which had a very special charm in it, and he had kept the audience intensely interested the whole evening. For him to say anything more would be presumption, and therefore he would sit down again expressing his appreciation.

MR. LLEWELYN B. ATKINSON said he had been delighted with the lecture and had learned a great deal from it. He was not a telephone expert in any sense, but he had been carried that night a very long way mentally on the subject. When he had been born the Atlantic telegraph was in existence; the world had got as far as that. It had been a very slow business and highly expensive. He recollected the invention of the telephone. He had seen what had been probably one of the first half-dozen sets made in this country. He had tried it as a boy in the house of an old friend—the father of one of his school companions, who had made it himself. He had been present at the first trials. He had seen the development of telephone exchanges from very small and rudimentary affairs up to what they were now, including the various automatic systems. He had seen the development of wireless telegraphy—before wireless telephony was thought of at all, when it had been purely the transmission of Morse signals at first over comparatively small, and then longer, distances. He had been living in South Wales at the time that Marconi had first come to England and succeeded in interesting Sir William Preece to trying his system. He had found an old letter which he had written to his father in the following terms:—"Preece had invited me to dine with him to-morrow night to meet a chap named Marconi, who claims to be able to send messages without wires." A few days after that Marconi had succeeded in demonstrating to Sir William Preece and to the British Post Office that he could send such messages. He had seen these things come about one at a time, so the audience could imagine that, as an electrical man, he had followed them all with the very deepest interest. Of later years developments had gone at such a pace that unless one was specialising, as the lecturer was, one soon got out of one's depth. That was why he valued the lecture, which, although it involved some technicalities, had been given in such an easy and clear style that most present, even those who possessed no technical knowledge, had understood the points and difficulties connected with the subject. The subject of broadcasting had not been dealt with, except in general terms—which reminded him of the proposition that the three ways of most rapidly distributing information were telegraph, telephone and tell-a-woman. The last was the broadcasting system.

MR. E. S. BYNG (Standard Telephones & Cables Limited), amplified in a few technical details the lecturer's diagram of the connection between the long distance exchanges and explained that this intermediate link, consisting of toll cable, loading coils and repeaters, represented a very important development which had taken place during the past ten years. The progress thus achieved had now made possible, technically and commercially, an "all-cable" telephone communication between practically all European countries, and although the radio links, as described by the lecturer, might play an important part in the connection of distant continents, there would, in his opinion, always be a need for a high grade type of cable and its accessories, which would continue to call for still further improvement and development.

A hearty vote of thanks to the lecturer concluded the meeting.

NOTES ON BOOKS.

SOME NOTES ON BOOKBINDING. By Douglas Cockerell. Oxford University Press. London: Humphrey Milford. 5s.

A concise, scholarly and useful little book, by a man whom we must regard as one of those chiefly responsible for the high standard maintained by a group of contemporary craftsmen.

The author does not exaggerate the material prospects that lie ahead of a novice in book binding. This is not a lucrative craft; but one wonders whether the caprice of fashion might not bring into existence a new society of amateurs, who would spend at least so much per year on finely printed and bound books. Such a turn of affairs is not unthinkable.

The latest show of bindings at the L.C.C. Central School of Arts and Crafts is the best witness to the value of the lectures given to the students by Mr. Cockerell, and here published with slight modifications. The specialist will appreciate the analysis of what constitutes efficiency in the various stages of production, and everybody will be interested in the author's general comments on the finished article.

The note reprinted at the end of the book is especially useful to owners of precious books and to librarians, as it deals with specifications and "how to give orders for binding."

BUILDING CRAFTSMANSHIP: IN BRICK AND TILE AND IN STONE SLATES. By Nathaniel Lloyd. Cambridge University Press. 15s. net.

The charm of a house or cottage depends not only on the main design but also on refinements of detail in the execution of the work. Small awkwardnesses are able, out of all proportion, to spoil the whole of which they are a part; see, for instance, Fig. 158 in Mr. Lloyd's book, from which it is obvious that excellent contours have to be supported in the right way by the right materials if they are not to be a failure.

In building, texture is both the surface generally and the inter-relation of the units of the surface. It is therefore actually one element in the design and so a more important factor even than in painting. In the case of old cottages which are by nature more charming than intellectual, texture and craftsmanship, the choice and application of brick and tile, are nearly everything. The layman may be surprised to find how much sophistication the harmonious treatment of these materials presupposes.

As Mr. Lloyd says in his preface, whether one is restoring or adding on to an old cottage, or building a new one, it costs no more to get those details right on which so much depends, than to get them wrong. I should like to see his book, in a cheap edition if possible, in the hands of all the country builders in England; some of whom, animated by the highest motives, occasionally spoil the ship for a ha'porth of tar which they do not really grudge. Those not animated by the highest motives might, on reading *Building Craftsmanship*, see the error of their ways and repent.

Mr. Lloyd's examples are divided between the anonymous work of old builders, whose unerring instinct for what was at the same time practical and beautiful is so often impressive, and the designs of eminent architects. Since Inigo Jones, England has nearly always been blessed with architects of great talent, in whom the scholar and connoisseur has by no means ousted the creative artist. Just as nothing reflects more credit on Ictinus than the section of his cornice mouldings, so nothing could illustrate more agreeably the versatile genius of Sir Edwin Lutyens

than details of his brick and tile combinations, as shown in this book. See Figs. 118 and 123. Admirable, also, is the finial with its gauged brick ball by E. Detmar Blow, Fig. 104.

Mr. Lloyd approves of fancy tiles for weather tiling, at any rate alternately with plain tiles, but there seems no doubt that only time can make them lose their air of affectation; they are apt not to be good in themselves.

An excellent book, happily appearing at a moment when one hopes that the movement for preserving old cottages has stimulated widespread interest in the subject with which it deals.

ALKALINE ACCUMULATORS. By J. T. Crenell, B.A., and F. M. Lea, M.Sc., A.I.C.
London: Longmans, Green & Co., Ltd. 10s. 6d. net.

The alkaline accumulator, a product of the present century, has not yet won its way to popular favour; indeed, it is probable that only a very small percentage of the users of accumulators have so much as heard of the existence of the alkaline variety. Nor is this because the ordinary or acid type is in any sense a satisfactory article. On the contrary, as everyone knows, it requires constant skilled attention if a reasonable standard of performance is to be obtained; and even under the most favourable conditions its life is short but far from gay.

The newer type of accumulator now under consideration, while it has its own faults, possesses sufficient advantages to deserve a special text-book. The authors have presented the subject in a commendably impartial manner, but they have succeeded in making it evident that such further progress as may reasonably be expected will probably place the alkaline accumulator in a very favourable position in relation to its acid competitor.

The terms acid and alkaline in the present connexion refer to the electrolyte solutions, sulphuric acid and caustic soda respectively, which are used in the cells, but of course the electrodes also are widely different. As is well known, the acid accumulator has a positive lead plate covered with lead peroxide, and a negative lead plate covered with spongy lead; but in the new type the positive material is mainly a mixture of nickel oxides held in contact with a nickel-plated steel plate, while the negative pole is roughly similar in construction, but holds a mixture of iron oxides, to which cadmium is sometimes added.

Feeling that little real comprehension of the subject could result without a grasp of the underlying theory, the authors have given a brief general account of electrode and electrolyte action. From the point of view of pure physical chemistry, this has been most admirably done, many customary fallacies having been carefully avoided. These theoretical sections constitute, in fact, a remarkable piece of accurate and sound summarization, and could be read with great advantage by many who are not specially interested in accumulators; one's only doubt is whether they will not be found too condensed by those who are not already familiar with these electro-chemical problems.

The main part of the book, however, is concerned with more practical matters, the manufacture, characteristics and treatment of alkaline accumulators are fully described, and their behaviour is compared with that of the acid type. The alkaline cells have a lower efficiency from the purely electrical point of view, their voltage during discharge is less constant, they are more bulky and more costly, and their state of charge at any instant is less easily ascertainable; on the other hand, they have a longer life, their maintenance is much simpler and cheaper, they retain their capacity at much higher rates of discharge, and finally the alkaline electrolyte, with its absence of fumes, is in many circumstances a decidedly advantageous feature.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4002.

VOL. LXXVII.

FRIDAY, AUGUST 2nd, 1929.

*All communications for the Society should be addressed to the Secretary, John Street,
Adelphi, W.C. (2.)*

PROCEEDINGS OF THE SOCIETY.

TWENTY SECOND ORDINARY MEETING.

WEDNESDAY, 15TH MAY, 1929

JAMES SWINBURNE, ESQ., F.R.S., Past President of the Institution of
Electrical Engineers, in the Chair.

The following paper was read —

THE REFORM OF THE BRITISH PATENT SYSTEM

BY ROBERT BURRELL, Barrister-at-Law

The subject upon which I have the honour to address you this evening, namely, the reform of the British Patent System, is a very extensive and important one, and it is obvious that in the space of one hour it would be useless to attempt to deal exhaustively with the subject. I understand that this Society may arrange further meetings at which it will be possible to go into some of the questions raised in more detail. In these circumstances it seems to me that the most useful contribution that I can make towards the discussion of the problem this evening, is to review in more or less a general manner the various difficulties of our present system as a whole, even if I am unable, to deal exhaustively with any particular case.

My task is considerably simplified by the work recently undertaken by the British Science Guild, which in April, 1927, appointed a very distinguished committee to consider the question. This Committee has recently issued its report, and this report contains a number of important recommendations covering most aspects of the question.

I think it will be convenient, therefore, in discussing the subject, that I should follow, as far as possible, the same order of treatment as has been adopted in the Report to which I refer. Before dealing in detail with the Report, however, I desire first of all to make a few general observations with regard to some of the points of view from which, in my opinion, the question of the reform of the British Patent System should be approached.

INTERNATIONAL CONSIDERATIONS.

The British Patent Law owes its origin to, and is still based upon, the "Statute of Monopolies," which was passed in the reign of James I. At that date industrial conditions in this country differed vastly from the conditions obtaining at the present time. The introduction of improved communications alone has completely altered the character of industry as we know it, from industry as it existed in the time when the Statute of Monopolies was passed. In the days of James I industry was, comparatively speaking, a local matter, whereas to-day the whole world are the potential customers of the successful industrialist. In considering the reform of the British patent system, therefore, it is important that the question should be regarded not merely from an insular point of view.

It may at first sight seem unnecessary when considering the reform of the British patent system to have regard at the same time to the patent laws in force in foreign countries. As a matter of fact, this is not so, and it is of the utmost importance not only carefully to consider the various systems in force in other countries, but also the terms of any international convention dealing with the subject of industrial property.

The value of a British Patent to a British manufacturer lies not so much in the monopoly which he thereby obtains in this country, as in the international monopoly obtainable on the basis of the application made in his country of origin. The extension of protection to foreign countries is regulated by the terms of the International Convention of Paris of 1883 as amended at the Hague in 1925. Great care must, therefore, be taken to ensure that no amendment of our existing system is introduced which will in any way imperil the very valuable privileges which may be secured if the terms of the Convention are duly observed.

The International Convention in its present form in no sense imposes on any Convention country any definite code of law, and is mainly concerned with the unification of the formalities necessary to obtain protection and with the establishment of a uniform period of priority.

This period of priority is of 12 months duration. Any applicant for a patent or equivalent protection in any of the Convention countries is, therefore, entitled at any time within twelve months of the date of application in his country of origin to apply in the Convention countries for protection, with priority dating back to the date of original application in his home country.

It should be observed that priority does not extend back further than the date of original application. If, therefore, any amendment of English law were introduced whereby the effect of a publication in this country prior to the date of application were modified, such amendment would, so far as the International Convention is concerned, be of no effect. I may, perhaps, illustrate what I have in mind by reference to the practice of the United States of America. Under the United States law it is not necessary that an inventor should lodge his application for protection before publishing his invention to the world, and under American law, two years are allowed after publication within which to apply for protection.

In many foreign countries, however, an invention, in order to be capable of protection, must be one which at the date when the application is made has not been previously published in any part of the world. As a result, many an American inventor who obtains valid protection for his invention in the United States finds, when he applies abroad, that he is unable to obtain protection owing to a publication made by himself in the United States prior to his application for protection in that country. This example illustrates the importance of paying due regard to the existing laws of foreign countries, and in particular to the terms of international industrial property Conventions, when considering the desirability of the introduction of any particular amendment into the British patent law.

There are, however, other reasons. We are an insular people, and are somewhat disinclined to trouble ourselves about the legal systems in force in other countries. In the last few years it has been my privilege to participate in a number of international conferences at which patent questions have been discussed, and I have been much struck with the close attention with which the development of the British patent and trade mark systems are watched by experts in other countries. In advocating any particular change in the English legal patent system, we must, therefore, remember that any such change will at once be carefully noted by those concerned in industrial property questions in foreign countries, and there is always the possibility that a change in the British law may be followed by a similar change in foreign law. This applies, of course, with particular force to the Dominions and the British Colonies and Dependencies.

I can well conceive circumstances in which a particular amendment of the English law might be suited to British industrialists, whereas the introduction of similar legislation in the patent systems of foreign countries, or in the Dominions and British Colonies, might be very detrimental to British interests. Indeed, the disadvantages might well outweigh the advantages to be gained by the introduction of the change into the British system.

The difficulty which British manufacturers encounter in obtaining adequate protection for their inventions in foreign countries is largely due to the fact that, although inventions are of international application and utility, the

protection in the various countries abroad must be obtained in virtue of the local laws, which laws are unfortunately lacking sadly in uniformity.

The International Convention of Paris is practically the sole instrument available for securing a larger degree of uniformity of law than has hitherto prevailed.

At the periodical International Conferences at which the text of the Convention is revised, the British Government has always insisted upon the desirability of international uniformity, and has done much to remove many of the irritating anomalies which have hitherto proved such a thorn in the flesh of British manufacturers. There have, however, also been complaints as to some details of the British practice, which, in some instances, is peculiar to this country. I refer, as an example, to the British practice of ante-dating a Convention application to the date of original application in the country of origin. In considering whether our British practice in this respect should be amended, even though we may be of opinion that the system of ante-dating is the correct and logical system, we ought, I think, carefully to weigh as against the disadvantages of introducing any change, the advantages likely to be gained by the adoption of a system which has uniformly been adopted by all the other countries of the Union except Great Britain and her colonies. If this country makes some sacrifices in the interests of international uniformity, she will be in a much stronger position to bring pressure on other countries to come into line on other questions perhaps of even greater importance, upon which at present there is no uniformity of practice. As an instance, I may perhaps refer to the question of third party rights.

The International Convention is next due to be revised at the London Conference of 1933. The duty of preparing the ground for the revision of the Convention at this Conference is, according to the terms of the Convention itself, entrusted to the Director of the International Office at Berne in collaboration with the Government of the country in which the conference takes place. The preparatory work in connection with the London Conference will therefore largely fall upon the British Government. It is, I think, important to mention this, because the acceptance by the British Government within the next three years of any of the principles underlying the recommendations made in the report of the British Science Guild would naturally bind the hands of the British Government in the preparation of the work for the International Conference.

SCIENCE GUILD REPORT.

Now I turn to the Report itself. In the Report the various questions are dealt with under seven headings, namely, Conditions of Validity, Short Term Patents, Applications for Patents, Proceedings before the Comptroller, Proceedings in the Courts, Availability to the Public of Information in the Possession of the Patent Office, and Financial Considerations. I propose

largely to follow this order of treatment, although owing to lack of time, I shall not be able to deal individually with all the recommendations made by the Committee. Although time is short, I am anxious also, if possible, to refer, although quite briefly, to one or two other matters not dealt with in the Report, but which, in my opinion, might usefully be discussed in connection with the Reform of the British Patent System.

The recommendations in the Report, taken as a whole, may be said to be directed to four defects in our present system, and the various reforms proposed aim at ensuring:—

- (a) A greater degree of security, both to inventors and the public, against the grant of invalid patents
- (b) The extension of the protection of the patent laws to inventions which are at present unpatentable, either because they are not "manufactures" within the meaning of the Statute of Monopolies, or because they are devoid of patentable subject matter, in the sense that they lack inventive ingenuity.
- (c) A reduction in the cost of patent litigation.
- (d) The reduction of the existing congestion at the Patent Office and the introduction of facilities ensuring a quicker patent grant than is at present possible.

NOVELTY.

Under the first of the above heads a number of far-reaching proposals are put forward by the British Science Guild. Important changes of law are suggested with regard to the official investigation as to novelty, the effect of prior publication by the patentee himself, anticipation of a patent of addition by the parent specification, the endorsement of doubtful specifications with warning notices as to the sufficiency of description, and the enumeration in the Act itself of the conditions of validity.

In order that a patent may be valid the invention claimed must, of course, be new. This condition, which is to be found in the Statute of Monopolies, is a condition which, so far as I am aware, is also to be found in the patent law of every other country. Under existing British practice prior to the grant of a patent, the application is subjected to a more or less strict examination by the British Patent Office, though this examination is of very limited extent, and does not extend to all the prior documents which may come under consideration, if the validity of the patent is challenged in the Courts on the ground of absence of novelty.

It is obvious that such an examination cannot give any guarantee as to the novelty of the invention claimed, and it has also other disadvantages. In the first place it weakens very considerably the value of British patents as compared with foreign patents which have been subjected to a more extensive system of search; secondly, it does not enable an inventor who is anxious to

obtain a cast-iron patent to obtain such information as is available in the Patent Office as to the state of the prior art; and, thirdly, it results in the grant of invalid patents, which until they have been challenged and proved to be invalid, may considerably hamper the legitimate activities of British manufacturers.

In this connection it must, of course, be remembered that the official search, though essentially directed to the question of novelty, also facilitates the drafting of a specification, in such a way as to disclose patentable subject matter.

In the Report it is first of all suggested that a patent should not be invalidated by the publication of any document more than 50 years before the date of the patent. If the search is to be restricted to the same period this suggestion seems to me to be based on sound common sense. It is admitted that its result might possibly be to confer validity on a few patents which would otherwise be invalid, but this disadvantage would be very slight as compared with the advantages which would follow. The chief advantage of the suggestion is, of course, that it would obviate the need for searching amongst very old literature in investigating the validity of the patent. I do not suppose that the suggestion will meet with much opposition. It is, in fact, already embodied in the Australian Patent Act.

OFFICIAL SEARCH.

The most important recommendation which is made in connection with the question of novelty is, however, the proposed extension of the official search to all such documents as would be citable against novelty as a defence in infringement proceedings. From the logical point of view I do not think that the proposals made by the British Science Guild can be questioned. Obviously the official investigation as to novelty should be coterminous with the investigations in infringement proceedings, or there should be no search at all. Under the French system, patent applications are not subjected to any kind of search as to novelty prior to grant, the whole question of novelty being left to the French courts. This is also a perfectly logical system.

The French system, however, is not one which is likely to appeal to British manufacturers. Indeed, even in France itself, there appears to have been a movement in favour of the introduction of a preliminary search. In France, however, the proposal was to establish two kinds of patents, patents granted without preliminary search, i.e., Deposit Patents, and patents granted after search, it being left to the free choice of the applicant to demand which kind of patent he preferred. Patents granted after search would be marked with a clear indication to that effect, in order to distinguish them from Deposit Patents.

A proposal on these lines was contained in the Patent Bill of Mr. Reynoldi, the French Minister of Industry and Commerce, which was recently submitted to the Chamber of Deputies. The idea underlying the proposal was that in

some cases it was of the utmost importance that a patent should be granted with the least possible delay, whereas in other cases delay was not a matter of much consequence provided that a patent could be obtained possessing some presumption of validity. Whether any such system would be acceptable in this country I very much doubt, and I accordingly only mention the matter from the point of view of interest.

I do not propose to deal here with the suggestions made by the British Science Guild as to the method which should be adopted in introducing the extended search, namely, in successive stages or instalments. Nor do I intend to refer in detail to the financial considerations involved by the proposal. It may be that the expense which would be involved by the introduction of an extended search would meet with considerable resistance from the Treasury, particularly if the present rate of renewal fees were to remain in force.

As to the desirability of the extension of the present search I have little doubt, and its practicability is merely a question of finance. If an extension of the search could only be secured at the cost of a substantial increase in rate of patent fees, the financial disadvantage might well outweigh the practical advantages which an extension of the search might give.

Unless the present examining staff of the Patent Office were considerably augmented, an extension of the present search would inevitably result in a lowering of the present standard of search, and an increase of the unfortunate delay which already exists at the Patent Office an dealing with patent applications.

The proposed extension, therefore, ultimately depends upon the assistance of the Treasury. By that, I do not mean that the Treasury should contribute towards the cost of the search, but that the Treasury should cease to appropriate for other purposes monies which have been paid by Patentees as their contribution towards the cost of maintaining an efficient patent service.

For myself, I have often wondered whether it would not be possible, to institute a central international office for search purposes, such office, of course, having no administrative function other than that of pure investigation, the result of such investigation being accepted by the Patent Offices of each country in lieu of a national search, and the effect of any citations being determined by the laws of each country. Very large sums of money are expended each year in the investigations carried out in the various national Patent Offices, and any duplication of the work, which must necessarily occur under the present system, is really a waste of money, and the loss, of course, ultimately falls on patentees and the public. In 1916 an International Arrangement for the establishment of a Central Office for Search was in fact signed at Paris, by nineteen Governments, including the Governments of Belgium, France, Poland, Roumania and Czechoslovakia, but the agreement was never ratified and proved quite abortive. Anyone interested may consult the text of the Arrangement in Volume 286, of the Official Gazette of the United States Patent Office at

page 646. The idea underlying the Arrangement is, in my opinion, an important one, though I recognise that there are immense practical difficulties. The establishment of a Central Office would, however, be of very great value to those engaged in industry, particularly if the information contained in such Central Office were available to the public on the lines of the recommendations contained in Section F of the Report of the British Science Guild. I may add, as a matter of interest, that the establishment of a Central Search Office was definitely advocated by the American Group of the International Chamber of Commerce at the Brussels Congress of the Chamber in 1925.

TRUE AND FIRST INVENTOR.

Whilst I am dealing with the question of novelty, there is one aspect of the question which does not appear to have been dealt with by the British Science Guild, but to which I may, perhaps, be permitted very briefly to refer.

In this country an invention will be held by the Courts to be novel if it has not been previously published within the realm, and any person who imports an invention into the country, whether he be in fact the actual inventor or not, is entitled as of right to obtain a patent in respect of such invention, such importer in law being "the true and first inventor". In this respect our law differs from the laws of most other countries, under which prior publication of an invention in any country will be held to invalidate the patent. At the time when the Statute of Monopolies was passed, travelling was still a somewhat dangerous occupation, and it was accordingly held that any person who imported a new invention into the country had rendered sufficient public service to merit the grant to him of a patent in respect of that invention. It is owing to the persistence of this theory that publications outside the realm do not affect the validity of a British Patent. Cases in which importation patents are obtained by a person who does not derive his title in some way from the true inventor are, however, comparatively rare, owing to the provisions contained in the International Convention which enable foreigners to obtain priority in this country for inventions originally applied for in a foreign country. If, however, to take an illustration, a German professor were, in the course of delivering a lecture before a learned Society in Germany, inadvertently to disclose an invention before applying for a patent in that country, it would be perfectly open to anyone to whom the invention had been disclosed to take the next train to London and obtain a valid patent for the invention in this country in his own name. Whether it is desirable to retain in our law a principle which enables such a borrowing of an invention belonging to another person is a matter which I think might well be further considered.

PREMATURE PUBLICATION.

The second proposal put forward by the British Science Guild under the head of Novelty is that publication made by or derived from an inventor

should in no case be pleadable against a patent subsequently granted to that inventor, provided that the patent was applied for within twelve months after such publication.

This proposal is, according to the Report, introduced to meet the hardships which sometimes occur in cases where an inventor inadvertently, or owing to ignorance of patent law, or through failure to realise the commercial importance of his invention, discloses his invention to the public before applying for a patent.

I am inclined to agree that the existing law may, in some cases, result in hardship. I am convinced, however, that owing to the international complications likely to result from the acceptance of the proposal, the matter is one which should be dealt with first of all under the International Convention.

The first difficulty which occurs to me is that the proposal would not, in any event, assist the inventor in obtaining protection in foreign countries. In many countries of the world, as I indicated earlier in my paper, a patent will be held to be invalid if the invention has been published in any part of the world prior to the date of application. Let us assume, therefore, that an inventor discloses in the United Kingdom an invention before a learned society on January 1st of this year, and applies for a patent on September 1st. Such prior publication would, according to the recommendations of the British Science Guild, not be pleadable against any patent obtained in this country as the result of that application. If, now, the inventor were to seek to obtain protection abroad, he would be able to apply for foreign protection at any time within twelve months of the date of his British application. But his period of priority would only date back to September 1st, the date of the British application. In those countries, therefore, in which prior publication in any part of the world is sufficient to invalidate the patent, the inventor would find that any patent obtained by him in such country would be invalidated by the publication made by him in Great Britain on January 1st. But there are also other difficulties.

One effect of the acceptance of the proposal would doubtless be to make inventors careless as to the publication of their inventions, forgetful of the fact that the amendment of the law proposed is a purely negative one, in the sense that no rights of priority are obtained by reason of any premature publication. Let us assume, as in the illustration already given, that A, a British inventor, discloses his invention before a learned society on January 1st of this year. B, a rival inventor, who is engaged on the same problem, independently makes the same discovery on June 1st and immediately applies for a patent, and soon afterwards publishes the invention. A then applies for a patent on September 1st. What is then the position? B obviously cannot obtain a valid patent because of the prior publication by A. But what is A's position? Although his own prior publication on January 1st is not pleadable against him, the publication by B is certainly pleadable, with the

result that any patent obtained by A will also be invalid. There are other difficulties besetting the recommendation of the British Science Guild in this connection, but the two illustrations which I have already given will, I think, be sufficient to emphasise the necessity of a very careful examination of the proposal before it is accepted. In any event, I am clear that the problem dealt with is a matter primarily for international regulation.

SECRET USER

In dealing with the question of novelty the British Science Guild also refer to the effect of prior secret user by a patentee, but they make no recommendation. I observe, however, that in Paragraph 11 of the Report in which this matter is referred to, the view is expressed that under English law a patent is invalid if it can be proved that the patentee had used the invention for profit before applying for his patent, even if no publication has taken place. I am aware that there are certain text book writers who have expressed a similar view, but there is no judicial decision which definitely establishes that proposition, and a number of weighty arguments might be adduced to the contrary. Having regard to the uncertain state of the law both with regard to prior secret user by the patentee himself, and to the effect of a prior secret user by a third person on the validity of a patent granted to another, it would in my opinion be useful if, in any revision of the English law on the subject of patents, both these questions were finally settled. There is a good deal to be said in favour of the proposition that prior secret user by the patentee himself ought not to invalidate any patent for which he might subsequently apply. Indeed, so far as the public is concerned, the consideration which it receives when a patent is subsequently applied for, namely information with regard to the invention, is the same whether any prior secret user has taken place or not. The same argument applies in a case where an independent inventor discloses to the public an invention which has in fact been secretly used by a third person. Whether in the latter case a patent should be granted to the person who first discloses the invention is doubtful unless some provision be made to protect the prior secret user. Such protection might, if necessary, be given by the insertion in the Act of provisions on the lines of Rules 62 and 63 of the Patent Rules which apply to the case of lapsed patents restored to the Register.

I might add that owing to the uncertain state of the law with regard to the effect of prior secret user by a patentee, it would appear desirable to add a proviso to the recommendation made by the British Science Guild as to the effect of publication made by or derived from an inventor who subsequently applies within 12 months of such publication for a patent. I doubt very much whether it was intended by the Committee that a person who had previously used an invention in secret should be entitled, at any time within 12 months after the secret had leaked out, to obtain a valid patent for his invention.

PATENTS OF ADDITION.

The Report also contains an important recommendation with regard to patents of addition. It is suggested that a parent specification should not be citable against a patent of addition as evidence either on the issue of novelty or subject matter. This recommendation is made with a view to encouraging an inventor to disclose improvements which experience has shown to be desirable in the working of his invention. It is important to remember, however, that one effect of the recommendation would be to enable a patentee at any time during the existence of the principal patent to obtain a patent of addition for any matters disclosed in the principal patent, but which he had omitted to include in the claims. This is a somewhat dangerous proposition, as it would result in permitting a patentee at any time during the existence of his patent, to extend the scope of his original claims. It has always been a principle of British Patent Law that what is not claimed is disclaimed and, in my view, that principle is sound and ought not to be departed from.

Furthermore, cases might easily occur in which the unclaimed matter in fact constituted a separate invention. If, in such a case, the Patent Office were to accept a claim for such matter by way of a patent of addition, the public would be helpless. No objection could be raised in opposition proceedings on this ground under Section 11 of the Act, and under Section 19 (4) of the Act of 1907, the grant of a patent of addition is conclusive evidence that the invention is proper subject of a patent of addition. The difficulty referred to could, of course, be met by a suitable amendment of Section 11.

With regard to the question of subject matter, the desirability of the recommendation made by the Committee depends upon the same considerations as are applicable in case of short term patents, and as I shall be dealing with these as a separate matter, I need not deal with the question at this juncture.

SUFFICIENCY.

In order that a patent may be upheld under the English law, the invention must be sufficiently described to enable a skilled worker to carry it out, and the invention must furthermore be useful, that is to say, the patented machine or process must actually function in the form in which it is described. At the present time the Comptroller's powers in dealing with a specification which, in his opinion, is insufficient, are limited to one of two alternatives; either he must refuse the patent or he must grant it, and the British Science Guild suggests that there should be some intermediate course open to the Comptroller, and that when in doubt, he should be entitled to call for *prima facie* evidence that the invention has been described in a practical form in the specification, and that if his objection is not satisfied he should be entitled to endorse the specification with a warning notice.

The idea underlying the proposal is a valuable one, but is, nevertheless, open to some criticism. The endorsement of specifications as suggested might

conceivably have a double effect, as it might lead to an unjustified inference in the case of specifications not so endorsed, that such specifications were, in fact, sufficient. I observe that the Committee, in paragraph 21, themselves admit that it is difficult to justify the requirement as to sufficiency in the case of patents for processes owing to the fact that at the date when the patent is applied for, the importance of some of the factors in the patented process may not be clearly apprehended by the inventor. In these circumstances it seems somewhat hard that an inventor should have to run the risk of having his patent endorsed with a warning notice, which notice would undoubtedly very seriously affect the commercial value of the patent. Furthermore, every patent specification must, of course, be read in the light of common general knowledge, which means the common general knowledge of those engaged in the art. It seems to me doubtful whether in all cases the examining staff of the Patent Office would have sufficient practical experience of the subject matter of the patent to justify the somewhat drastic expedient of endorsing a specification with a warning notice as suggested. The fact that, in the opinion of the Committee, which is no doubt justified, the recommendation would be exercised in a reasonable and not in a vexatious manner, is reassuring, but does not completely meet the difficulty.

BIOLOGICAL INVENTIONS.

I now pass to the recommendations made by the Science Guild with respect to the extension of the protection of the patent laws to inventions which are at present unpatentable. Under this head the Report treats only of inventions, such as biological inventions which are at present unpatentable, on the ground that they do not constitute a manner of manufacture under the Statute of Monopolies. I propose, however, to include under this head also the recommendation to establish a system of short term patents. In my view the importance of the recommendation made in regard to short term patents lies not so much in the fact that they would be obtainable more promptly and cheaply than full term patents, but because their validity could not be impeached on the ground of absence of subject matter.

The limitation of the grant of patents to inventions relating to a "manner of new manufacture" is derived from the Statute of Monopolies. In the introduction to the Report, the importance of the growth in scientific knowledge arising from research in pure science is very properly emphasised, and it is pointed out that not only the volume of invention but also its trend has been completely altered by modern research, notably in the chemical and biological sciences. The limitation of the definition of patentable inventions to which I have referred has had the effect of rendering it practically impossible to protect by means of patents biological inventions of value, particularly in the agricultural industries. In the Report rust-proof wheats and new applications of parasites for destroying weeds are cited as examples.

Whether the present depression in our agricultural industry is in any way due to the fact that improved biological products are at present unpatentable, is somewhat doubtful. But there can be no little doubt that if biological inventions were freely patentable, more capital might be unloosed to further agricultural progress. Considerable difficulties would necessarily be encountered in devising any means whereby such patents might be rigidly enforced, but the enforcement of such patents is a matter which, as suggested in the Report, might fairly be left to the test of time. Apart from biological inventions, there are also other inventions of a useful nature, which are at present unpatentable owing to the words of Section 6 of the Statute of Monopolies. I refer, for example, to processes involving electrical action at a distance. The British Science Guild only refer in their recommendation to biological inventions, and whilst agreeing that such inventions should be patentable, I venture to express the view that there are also other inventions which are capable of commercial exploitation and for which protection should be ensured by some amendment of the present Act. With regard to biological inventions concerning medical treatment, I observe that in the Report it is suggested that in view of the strong contrary opinion of the medical profession these should not be patentable. Personally, I doubt whether the fact that the medical profession is opposed to the grant of such inventions should be regarded as conclusive.

If any amendment of the Act be introduced on the lines suggested in the Report, an attempt should be made to secure such amendments of the International Convention as would enable the protection for the inventions contemplated to be extended to other countries.

SHORT TERM PATENTS.

Now I must deal with the question of the desirability of the introduction in this country of a system of "short term patents," analogous to the system of "Gebrauchsmuster" established in Germany in 1891. I believe I am correct in thinking that Germany is the only country which so far has introduced a system of the kind. The difficulty with which the British Science Guild is attempting to deal arises from the fact that intermediate between inventions protected by patents and industrial designs which are at present protected under the design provisions of the Patents Acts, there is a further class of invention which at present lacks protection. Under the design laws one can only protect such features of shape, configuration, pattern or ornament which as applied to any article by any industrial process appeal to the eye, and such protection does not extend to any mode or principle of construction or anything which is in substance a mere mechanical device. The class of articles which the British Science Guild has in mind includes, for instance, utensils, tools, or machine parts of novel and convenient shape and machines of known types having a novel layout of component parts. Under the existing system the protection of such articles is difficult. If protected under the patent laws

many such articles, although new and useful, may, according to the Report, not have sufficient subject matter to justify the grant of protection. If protected as designs they are only protected in so far as their external shape or configuration is concerned.

Apart from these two difficulties there is also the third difficulty that if application be made for protection under the patent laws, so long elapses before the patent is accepted that in the case of many of these articles, the success of which is dependent upon quick sales, the protection when eventually obtained is too late. The articles in question are articles which can be quickly copied, and as no damages can be claimed by the patentee prior to the date of the acceptance of his complete specification, unscrupulous competitors do not hesitate at once to place infringing articles on the market. This difficulty is particularly felt by the manufacturers of seasonal articles, such as, for instance, mechanical toys which are sold in such large quantities during the Christmas season.

It is proposed by the British Science Guild that protection should be granted for this class of article by means of what are termed "short term patents," which patents should not be liable in the same degree as full term patents to invalidation on the ground of lack of subject matter, it being generally sufficient that the innovations protected by them be new and useful. The term of protection proposed is a term not exceeding seven years. It is suggested that the grant of such patents should be prompt and cheap, and that their scope should be narrow and restricted; the claims, for instance, being restricted to one or two in number, each claim ending with some such phrase as "substantially as described and shown in the accompanying drawings." It is not clear from the Report whether it is intended that short term patents should be subjected to any search as to novelty before grant, but I assume that there would be no search, as the proposals involve a prompt grant of protection.

I have no doubt that the chief objection which will be raised to the proposal will be directed to the suggestion that monopolies should be granted in respect of any invention which is devoid of subject matter. Indeed, reading between the lines, it seems as if the members of the Committee of the British Science Guild themselves were not fully convinced of the desirability of this condition. I say this because in defining the privileges to be granted to short term patents the Committee does not in terms state that no degree of inventive ingenuity shall be required. The words used are these: "British short term patents shall not be liable *in the same degree* as full term patents to invalidation on the ground of lack of subject matter. It should *generally* be sufficient that the innovation be new and useful." No information is given, however, as to what is meant by the words "in the same degree" or the word "generally" in the passage to which I refer. It is difficult to understand the effect of the words "in the same degree" if indeed it is intended that they should have any

meaning at all, because under recent decisions of the Courts in certain patent cases even a scintilla of invention is sufficient to support a patent which is new and useful. Thus in the case of Guisti's Patents, reported in 40 R.P.C., page 206, Mr. Justice Astbury, in dealing with an infringement action relating to a patent for tin openers, said this: "I care not how simple it is if it is not an obvious thing, and if the production of it was not a mere workshop improvement on a well-known tool. If it involved invention, *however slight*, I think the patent ought to be supported, and it must be borne in mind that the claims of the patentee do not cover any article proved to have been previously made or described."

The case to which I refer is specially relevant because the invention in question was in respect of a tin opener, that is to say, one of the class of articles which the Science Guild proposes should be covered by short term patents.

The decision seems to me to cast some little doubt as to the necessity for the condition proposed in the Report as to "absence of the same degree of subject matter." In the case of a humble invention the Courts already seem to be satisfied with a considerably less degree of subject matter than appears to be requisite in the case of complex inventions.

I must confess that I am in agreement with the view that some amendment of the law is required to facilitate the protection of small but useful inventions of the class referred to. I have serious doubts, however, as to the desirability of the method proposed by the Science Guild for achieving that object. It is possible that one effect of the introduction of short term patents would be unduly to restrict the development of his invention by a patentee who has protected his invention by an ordinary patent. It seems to me probable that on the publication of the specification of an important patent many attempts would be made by third persons to protect obvious variations in the constructional form or arrangement of the machine by means of short term patents. The use of any such variations might well come within the ambit of the claims of the original patent, so that their use could be restrained by the original patentee, but the original patentee would not himself or by any of his licensees be entitled to use any of the particular variations which happened to be protected by these short term patents without paying a royalty to the owner of such short term patents, even though the variations protected were perfectly obvious and involved no inventive ingenuity of any kind. This danger could not be easily guarded against by any amount of care in the drafting of the original specification of the letters patent of the main invention, and a prudent patentee would therefore be obliged to supplement his original application by a large number of short term patents, thereby very materially adding to his overhead expenses.

Secondly, there is the difficulty arising from some of the general considerations to which I referred in the opening paragraphs of my paper. It might very well be that the introduction of the system in Great Britain might be followed by the

introduction of similar systems in many other countries. If that happened, a British manufacturer who desired to incorporate some small variations into his patented machine, produced perhaps on mass production lines, would be bound to incur the very great expense involved by searches in a large number of countries, before he could be certain that the variations could safely be made use of.

At the same time I feel the force of the argument that the system has been in force in Germany for nearly 40 years, and that every year nearly 51,000 Gebrauchsmuster are applied for. I also recognise that Germany is the country which has specialised in the manufacture of novelties and small tools and has built up a very valuable trade in such articles, and it may be that there is some connection between the growth of this particular trade in Germany and the establishment in that country of the Gebrauchsmuster system. Whether this is so or not I am unable to say. The fact that Gebrauchsmuster are applied for annually in such large numbers may on the other hand be due to the fact that ordinary patentees have found themselves obliged to supplement their patents by Gebrauchsmuster for their own protection.

In any event, I feel that a very careful enquiry should be made into the actual operation in Germany of the Gebrauchsmuster system before any similar system is introduced in this country.

The difficulty arising from the fact that in some cases, as for example, seasonal goods, the present patent delays render ordinary patent protection quite useless can be met in other ways than by the introduction of short term patents. Thus an amendment of the law might be introduced enabling damages for infringement to be recoverable in respect of infringements committed before the publication of the complete specification, provided that the patentee is able to show that the infringer had notice that an application for patent protection was pending.

LEGAL PROCEEDINGS.

I am afraid that as time is short I can deal only very briefly with the recommendations made with a view to reducing the cost of patent litigation. I must, however, refer to the very important suggestion that patent actions should be tried before the Comptroller, and that appeals from the Comptroller should be to a special Judge in Chambers instead of to the law officer as at present. I can see no real reason why infringement proceedings should not, with the consent of the parties, be heard by the Comptroller. In some cases the expense of such hearings might not be very much less than the expenses which would be involved in High Court proceedings, but in such cases the parties would probably prefer in the first instance to proceed in the High Court. There are many cases, however, in which a patentee is deterred even although he has a valid cause of action from taking proceedings, owing to the very great expense usually involved in patent proceedings in the High Court. In cases of this kind the suggestion made by the British Science Guild has particular force.

No reference is made by the Guild to the issue of certificates of validity. These should not, I think be granted by the Comptroller, but should be reserved for High Court judges. Subject to that exception, however, I can see no valid argument against the proposal. I am also strongly in favour of the suggestion that appeals from the Comptroller's decision should be heard by a special judge. The present procedure has obvious difficulties, as has been admitted on many occasions by the Law Officers themselves, particularly in cases in which technical questions are involved. It has been suggested that, the granting of patents being a prerogative of the Crown, appeals should constitutionally only be heard by a law officer of the Crown. Historically, this may be perfectly correct, but the argument carries little weight when the present practical difficulties are considered.

Whilst I am dealing with the question of legal proceedings I ought perhaps to refer also to the recommendations in the Report regarding the remedy available in the case of unwarranted threats of legal proceedings for patent infringement. The present Section is undoubtedly insufficient, because there is no remedy for threats based on a provisional specification or on a complete specification before the date of sealing, and furthermore the threatener can escape retribution by beginning an infringement action with due intelligence, even if he abandons it as soon as the defence has been put in. I strongly support the suggestion made by the British Science Guild that Section 36 should be amended so as to cover these cases.

PATENT OFFICE DELAYS.

I have already referred in an earlier part of my paper to delays which occur at the Patent Office in dealing with patent applications. The suggestion made by the British Science Guild that when an indisputably complete anticipation has been found, time should not be wasted in collecting further references is useful, but would, of course, not have much effect on the present delay. I doubt also, whether the institution of a system of short term patents would relieve the present congestion—in fact, it might conceivably add to it, as I observe that in Germany the number of patents deposited annually has not been materially affected by the establishment of Gebrauchsmuster.

The only remedy is an increase in the strength of the examining staff. In the Report figures are given which show that whereas in the last 16 years the number of complete specifications filed has increased by 26.2%, the strength of the examining staff has decreased by 9.9%. Since the Report was written further figures are available which show that whereas on July 18th, 1928, 6,300 complete specifications were awaiting first action, the arrears were accumulating at the rate of 67 per week. On February 26th, 1929, the arrears had amounted to 8,400, and were increasing at the rate of 76 per week. The position is a serious one for British industry, and should be remedied without delay. As the British Patent Office is being administered at a handsome profit, there is little reason

comparatively few patents out of all the number of patent applications made, due to the fact that the vast majority of patents lapse long before the sixteenth year owing to failure to pay the renewal fees. The British Science Guild, however, suggests that it might be as well to introduce no change in the British practice with regard to the publication of Convention applications until foreign nations are prepared to make reciprocal concessions as regards third party rights. The reason why this proviso was introduced is no doubt because a similar proviso was inserted in their recommendations by the Dating and Sealing of Patents Committee. I very much doubt the wisdom of deferring the reforms proposed for the reason given. Under the terms of the International Convention it is provided that patents applied for in the various countries by subjects of the contracting countries shall be independent of the patents obtained for the same inventions in the other countries as regards their nominal duration. The practice of ante-dating a Convention patent to the date of original application in the country of origin is peculiar to Great Britain and some of her Colonies, and the other Convention countries have always complained that the British practice of ante-dating and throwing open to inspection of Convention applications involves a breach of the spirit if not of the terms of the Convention, to which Great Britain is a party, and it was this complaint, renewed at the Hague Conference of 1925, which resulted in the setting up of the Dating and Sealing of Patents Committee.

It is true that certain foreign countries which permit their own nationals to acquire what are known as rights of personal possession during the interval between the date of application in the country of origin and the date of application in those countries by foreigners under the Convention, are themselves equally, if not more, guilty of a breach of the spirit of the Convention. Nevertheless, it seems to me invidious for any one country which is regarded by its fellow contracting countries as acting in breach of Convention to make the remedying of the breach in any way conditional. There is also much to be said for the view that if Great Britain were at once to alter its practice in this respect to conform with the views held by practically every other Convention country, it would be able at the forthcoming London Conference to exercise very much greater influence on Italy and Hungary, which are the two recalcitrant countries so far as third party rights are concerned.

Quite apart from the international aspect of the question, however, the proposal that the period between the filing of the provisional and complete specification should be extended to twelve months so as to coincide with the priority period under the International Convention would be of considerable value to British patentees. I am assuming, of course, that at the same time the period allowed for acceptance is increased as suggested to eighteen months with extensions up to a total of twenty-one months.

I think, however, that if there is a limit placed on the time within which an applicant must get his application accepted, a definite limit should also

be placed on the Patent Office within which to take the necessary Office action.

I doubt the wisdom of insisting on throwing open to public inspection applications which have not been accepted, even if advantage be taken of the full extended period proposed.

A further suggestion made by the British Science Guild that it should be permissible to file under the International Convention a single British application in respect of two or more foreign applications relating to cognate subject matter seems to be sound, and would follow the acceptance of the principle underlying the recommendation of the Dating and Sealing of Patents Committee that applications for patents abroad should be assimilated with British provisional specifications. This is a question, however, which ought to be dealt with by the International Convention itself.

I might add that this particular recommendation received the full support of the International Chamber of Commerce, who in 1925 suggested the inclusion in the International Convention of a similar provision. Whilst I am dealing with a question which refers to the International Convention it would perhaps not be out of place to allude to one further matter which is not dealt with by the British Science Guild, but which creates difficulties in connection with applications made in this country under Section 91 of the Patents and Designs Acts.

Under that Section a foreigner is entitled within twelve months to apply in this country for protection in respect of any invention "for which protection has been applied for in the foreign state." Difficulties have arisen with regard to the interpretation of the words "for which protection has been applied for in the foreign state." The principle underlying the International Convention is that for the purposes of priority an application for protection in a Convention country shall be regarded as having been made simultaneously in all the other countries of the Union. In some countries it is not necessary that any specification should be accompanied by detailed claims. Under British practice, however, protection is refused in respect of a Convention application if the invention claimed in this country is larger than the invention actually claimed in the country of origin, even although the invention claimed in this country is in fact fully described in the body of the specification originally filed abroad. The British practice is, in my view, contrary to the spirit of the Convention and should be amended, and protection in this country should not be refused merely because the British claims do not coincide with the claims filed abroad.

There is, I am afraid, insufficient time for me to deal individually with all the other matters dealt with in the Report of the British Science Guild. These deal inter alia with the post dating of applications, the conversion of a complete into a provisional specification, disconformity, the extension of time in opposition and revocation proceedings, and many other matters of no mean importance to patentees and others interested in the operation of the Patents Acts. There

are also a number of very valuable suggestions with regard to rendering more easily available to the public technical and other information in the possession of the Patent Office. I have not referred to them because the Report itself is readily obtainable by any person interested, and I have no special comment to make with regard to those recommendations except to approve generally of them.

British inventors and manufacturers interested in patents are very much indebted to the British Science Guild and the very distinguished gentlemen who served on the Committee of that Guild, and whose deliberations have resulted in the Report with which I have been dealing to-night. The Report has aroused lively interest not only in this country but also abroad, and is now being carefully considered by many organisations which are interested in patent questions. I also believe that, as the result of the issue of the Report, the President of the Board of Trade has already consented to appoint a Committee to enquire into the operation of the British Patents Acts. When sufficient time has elapsed for the Report to have been properly digested by all the organisations which are now considering it, it would be extremely useful, if I may venture to make the suggestion, if the British Science Guild were to convene a national conference of all the organisations interested, so that the various suggestions contained in the Report may be further considered from all points of view and any divergent views brought into harmony.

DISCUSSION

THE Chairman said it was very fitting that they should have had such an excellent paper read before the Society of Arts because though probably most of those present would not remember it the Society took a very active part in 1850 when the patent law of this country was improved.

MR J W GORDON K C said he had been very much interested as he was sure they had all been in the paper which had just been read. Patent law was of course, a subject of paramount interest to a very large number of our manufacturers. It was also of interest to those who were the customers of manufacturers because everything that facilitated the introduction of improvements into our manufactures was a matter, not merely of manufacturing interest but of national importance. From that point of view any question which affected the terms or the administration of our patent law was of much more than merely technical interest and importance. The paper dealt with the subject in a manner that must he thought, strike everybody as being singularly detached and able. Everybody would approach the report issued by the British Science Guild with a certain feeling of respect due to an expert body which was dealing with a subject of great technical intricacy as well as of great practical importance. The lecturer had discussed with great freedom the suggestions of that Committee and had criticised those suggestions in a way which had the great merit of being not only independent and searching, but also of being distinguished by very good judgment. The value of any work which was intended for practical uses must depend to a very large extent on the manner in which it elicited. No body of people could be expected to sit down and

meditate upon a subject with however much industry and concentration and produce the best result ; all the work, and especially all the technical work, that was done in the world was greatly improved by criticism. He had no doubt that the work of the British Science Guild would be very much improved by being subjected to criticism of the sort that had been given by the author. Nothing that he had said in his paper was unjust or captious ; on the contrary, the free criticism of the report which had been put forward was, he ventured to think, the best way of dealing with a report of this kind. In view of the fact that he (the speaker) had not seen the paper before it was delivered, he would not venture upon any detailed additions or remarks on the subject matter of the paper. It was a matter in which he himself had been considerably interested for a long period, but his interest had not been that of the manufacturer ; it had been a detached interest. It was therefore proper that he should limit himself to general observations. He desired to thank the author for his paper.

MR. H. C. HAYCRAFT (Assistant Comptroller, H.M. Patent Office) expressed the pleasure and interest which he personally had felt in listening to the paper. He was afraid it was impossible for him to take part in the discussion ; his position at the Patent Office debarred him from doing so. He felt he might, however, say that the Patent Office was always prepared in a hopeful spirit to undertake any responsibilities which Parliament might think fit to entrust to them, their attitude being that it was " Theirs not to reason why ; Theirs but to do or die " ; and he was inclined to think that the latter of those two alternatives might be their lot if effect were given to all the reforms of which the author had expressed approval.

MR. H. A. GILL said that, though he was not in the same position as Mr. Haycraft, he was a little tied in other ways, having been a member of the British Science Guild Committee which had produced the report ; anything, therefore, that he said otherwise than in favour of that report would hardly be received with approval. The author had criticised the report in several respects ; he (the speaker) thought those criticisms were quite pertinent, and should be considered, they were not in any way unkind, but were merely calculated to ensure greater care in carrying out the recommendations of the British Science Guild, and that adequate safeguards should be provided. The author had apparently received an adverse opinion from Germany of the *Gebrauchsmuster*, or short-term patent system, in that country, it being said that a large number of those short-term patents were probably invalid. The facts, however, spoke for themselves : the number of these short term patents was steadily growing, very great use of them was being made by German manufacturers, and he (the speaker) had not heard of any complaint in Germany that such patents had been used, as the author had suggested, to obstruct the normal development of inventions of a patentable nature. The author had suggested that smaller manufacturers might be on the watch for big inventions coming out in order to produce minor inventions for which short-term patents might be taken out, with a view perhaps not of blackmail, but of making it difficult for the bigger manufacturers to work those substantial inventions without obtaining permission to use the minor inventions. He did not think that had been at all the case in Germany ; on the contrary, these *Gebrauchsmuster* had filled a definite gap between the registration of articles merely with regard to external shape and appearance and the patenting of inventions. The procedure had been hedged about so as to make it impossible for undesirable practices to be resorted to. If such a system were introduced in this country it would be found that the Patent

Office would be relieved of a burden which was at present on its shoulders, because everybody was trying to register as designs for fifteen years things which should be of the short-term patent order.

MR. A. JAFFÉ expressed his appreciation of the paper; he was very glad that the author, in the body of the paper, had gone beyond the title of the paper "The Reform of the British Patent System," in that he had pointed out the great importance of looking at this matter not from the insular but from the international point of view. We had moved very far from the days of the Statute of Monopolies, and it was more important than ever that the international point of view should be preserved.

MR. B. E. DUNBAR KILBURN said he had listened to the paper with great interest. Like Mr. Gill, he felt that his position was curious, in that he had been a member of the committee which produced the report upon which the author had commented. Those comments were extremely good; he would not be sorry if that Committee had an opportunity of reconsidering their report in the light of the author's remarks, but he supposed that was impossible. He desired to express his agreement with what Mr. Gill had said as to the short-term patents; he did not know that the author appreciated the extreme difficulty which was experienced in dealing with those inventions, if they could be so called, which were between designs and patents. As a matter of fact, there had been for a long time a demand for the sort of protection that was given by a short-term patent. Difficulties were also experienced in the registration of designs. The question had been discussed elsewhere, not many days before, in connection with copyright. The situation with regard to designs was unsatisfactory, and something ought to be done. He saw no reason why the short-term patent system should not afford a way out of the difficulty, at any rate, to a considerable extent. The author seemed to think there would be international difficulties with regard to short-term patents; he (the speaker) could not see why; in fact, he would go the length of saying that if short-term patents were introduced everywhere it would be advantageous; he saw nothing against it.

CAPTAIN C. W. HUME (British Science Guild) expressed his appreciation of the acute criticisms and lucid presentation of the paper; it was a paper which he was sure all those interested in this subject followed with the greatest possible interest. There was a good deal that he desired to say in detail, but he was in the unfortunate position of being already in "hot water" for the part he had taken in preparing the report, and was unwilling to commit any further indiscretions because he saw around him several of his official superiors from the Patent Office. He only knew of two books dealing with the economics of the patent system; one was an American book and dealt with the American patent system, while the other was a book by Mr. A. F. Ravenshear, whom he was glad to see present, and who in 1908 gave the subject a most careful and lucid analysis. It was, he thought, obvious to everybody that inventions had an intimate bearing on unemployment; that was illustrated by the Luddite riots on one side, and by the enormous employment which had resulted from such inventions as that of artificial silk, on the other side. Mr. Ravenshear had analysed the effect of a good patent system on employment; he (the speaker) would not say more than this, that he thought Mr. Ravenshear proved that a good patent system was a great benefit in relieving unemployment, whereas a bad patent system was, of course, bad for everybody.

He did not wish to express any opinion as to whether the British system was good or bad or could be improved, but he did wish to emphasise the importance of having it as good as it could possibly be.

DR. ARTHUR HAYDON said he desired to discuss the matter not so much from a legal or economic point of view, but rather from a scientific point of view. He thought it would be as well to have a few definitions of what substances could be patented; he was thinking of patent medicines and substances such as "pneumosand," which was really a preparation of tuberculin for the treatment of consumption and other diseases. If it were not considered irrelevant, it would be interesting if the lecturer could give them some opinion as to what substances were clearly outside the region of the Patent Office.

MR. JOHN HETTINGER thought the most important part of the paper was that dealing with short-term patents or *Gebrauchsmuster*, as they were called in Germany, and was very pleased to notice that that question was referred to by most of those who had taken part in the discussion. It was common experience that patents as to which patent agents had advised that there was no subject matter in them, were passed by the Patent Office, who seldom could refuse the grant, only to be subsequently found invalid by the Courts. The position was especially serious in connection with wireless apparatus. He had frequently been advised by counsel that patents on wireless apparatus which had been passed by the Patent Office had, in fact, no subject matter, and yet the articles were very successful in practice and exhibited at the Olympia Exhibition by a large number of firms. What was the position in such a case? They had an article which was undoubtedly new and was of proved utility, and yet everyone said it had no subject matter. He thought the Patent Office very well knew that a good many patents were granted for subjects which were not really subject matter for a patent. He submitted that the introduction of something intermediate between a patent and a design was good common sense. The author had received information from Germany to the effect that manufacturers did not like the *Gebrauchsmuster* system. The information which he (the speaker) had obtained was to the contrary— that they did like it. One point had been overlooked in the discussion: a good many of the *Gebrauchsmuster* were filed simultaneously with the patent application, the reason being that the *Gebrauchsmuster* was registered within two to four weeks; if it was an article such as was used in wireless, for instance, it could be put immediately on the market and infringements could be stopped. The author had pointed out a difficulty which might arise between the *Gebrauchsmuster* and the ordinary patent, that somebody might obtain a patent with a good wide claim, and then other people might come along and file any number of *Gebrauchsmuster* with practically no subject matter. But the holder of a valid patent could stop infringement or exact a royalty; on the other hand, there was no need for the patentee to file any number of *Gebrauchsmuster* if there were so many obvious imitations. He therefore repeated what he had said in the beginning of his remarks, that so far as the *Gebrauchsmuster* was concerned it was a commonsense proposition and a necessity. He had dealt with the present unsatisfactory position, and the remedy by way of "Utility Patents," in a short article published in the *Lecturian* (p. 253), of August 26th, 1927.

MR. A. H. DYKES said that although he was exceedingly interested in patents and had committed the indiscretion of taking out a fair number himself, he did not claim to be an expert in Patent law. He did, however, desire to allude to a

point which was, he thought, germane to the discussion, although it did not directly bear on it. The object of reforming the patent law was, he took it, to encourage research and invention; the best way to do that was to see that those who devoted their time to that research and invention reaped the reward of their work. There was one subject which he had taken up more than once; he had taken it up with the Comptroller of the Patent Office, and also with *The Times*, which had been good enough, a year or two before, to take up the matter and comment on a letter he had written. It was that a very large proportion of patentees were not very wealthy men; when they got out a patent they very frequently spent what was to them a very large sum of money in preliminary work; finally, they possibly got their patent taken up on a royalty basis. But directly they received their first royalties the income-tax people came down on them, charging them income tax on those royalties at the unearned increment rate. He submitted that was absolutely wrong, because if ever there was an income properly earned it was an income from patent royalties. The inventors were not allowed to deduct for income-tax purposes preliminary expenses to which they might have been put before they got those royalties, an inventor might have spent £500 or £1,000 on preliminary expenses, but when he got a £5 royalty he was not allowed to set off against that his expenses, he had to pay income tax at the full rate on that amount.

MR. F. F. TOWLER said there was one aspect of what the author called the extension of patentable subject matter which should be given a little further consideration than it had received. The report of the British Science Guild recommended and the author appeared to agree with the recommendation - that there should be an extension of patentable subject matter in the direction of allowing, for instance, biological inventions to be patented; but with regard to such inventions he was unable to see that there would be any consideration that the patentee could give for the grant of a patent. That had also struck him with regard to some things which were actually patented at the present time; for example, inventions in connection with the production of substances by means of particular bacterial cultures. If a man produced, say, a rustless wheat, nobody was going to go to the trouble of reproducing that same wheat when once it had been produced, it would always be simply reproduced in the ordinary biological way by the seeds of the parent plant; all that the patentee could give in his specification would be an account of the manner in which he had produced that particular species or variety. Whilst that account might be of considerable value to future biological research, there would be nothing in it that would enable the public at the end of the monopoly to produce what the patentee himself had produced. That same consideration held good with regard to the production of certain substances by means of bacterial cultures; the patentee would describe how he obtained the particular bacterial culture, but it was not to be supposed that anybody would take the trouble to produce that particular strain of bacteria again; he would simply carry on his work with some that he had produced from the strain that had already been isolated.

MR. H. J. NEILL desired to say a few words on one point which had not been dealt with except by the author; that was, the proposed extension of the Patent Office official search to cover more than British patent specifications. Any search for novelty meant a search to find out that there was not anticipation; such a search could never be conclusive because it would be manifestly ridiculous to suggest that every printed document in the world could be examined. The consequence was that the best a search could do was to give a reliable indication

of the state of the art or industry. The search that was at present made by the Patent Office afforded a very good indication of the state of the industry in this country. Further investigation and research, particularly foreign investigation, would involve patentees in very considerable expense in obtaining their specifications; it would mean the obtaining of foreign specifications, which was not easy, and their translation. For those reasons he thought the extension of official search beyond the British specifications would not, by the benefit it gave, justify the additional expense on the part of the Patent Office, and the additional trouble to which the patentee would be put. If the patentee wished to assure himself by the very best advice that his patent was going to be valid, he could have conducted on his behalf a search as expensive as he liked, and if he thought his invention was worth such expense, he would do so. To extend the scope of the official search would be putting an unfair onus on the patentee. He thought another point had not been appreciated in the remarks that had been made on the short-term patents for utility models. Some time before he had had a long talk with two German patent agents on this subject, and had come to the conclusion, as the result of what he had heard from them, that the requirements of subject matter or inventive ingenuity for obtaining and holding valid a German patent were very much higher than the requirements for obtaining patents in this country. The requirements for holding valid a German *Gebrauchsmuster*, although not quite as high as the requirements for holding a British patent, were getting on that way. A British patent at the present moment was granted and could be held, as had been pointed out by the author, on the merest scintilla of invention. Were we going to grant any form of patent for anything lower than that? If in this country we were going to have these short-term patents, it seemed logically to follow that the requirements for a full-term patent must be a really substantial invention, it probably being a requirement, as it was in Germany, that it should be for doing something new, and not merely for doing an old thing in a different way. Before a petty or short-term patent system could be introduced into this country, it would be necessary to alter by some means or other the requirements for validity of the full-term patent which would have to be of more substance than they were at the present time. If that were done, there was undoubtedly room for the utility model patent, but with the requirements as to subject matter which the Courts now imposed, there was absolutely no room for anything of smaller subject matter, and particularly of less inventive ingenuity.

THE CHAIRMAN said they had had a very interesting discussion, he did not want to add much, because criticising the paper would be rather like reviewing an encyclopædia. He merely wished to mention one or two points which he did not think had been mentioned. There was the question of the Comptroller acting as a Judge in these cases. Just at present they happened to have extraordinarily good men at the head of the Patent Office, but some of those present had memories, and perhaps it would not always be as it was now. But, even at the present time, the Patent Office officials had as much work as they could possibly do. Apart from that, the principle was fundamentally wrong. People who were to exercise judicial functions should be trained as lawyers, should be capable of weighing evidence, and should really have the sort of training that a Judge had. It had often been suggested that it would be a good thing for patents to be referred to arbitrators; he submitted that that was entirely wrong, because the arbitrator had to be an expert, and experts had not always the judicial capacity which was necessary in dealing with a patent.

The next point was that of compelling patentees to work their patents in the country in which they were protected. They might think he was a Liberal, or something dangerous of that sort, but, as a matter of fact, he was not a politician at all; he was a student of economics, and wished to point out that the idea of working patents in the countries in which they were protected was really bad economics; it was a form of protection and was really derived from the fundamental errors at the basis of protection.

He was afraid he would be against the general feeling of the meeting with regard to small patents. The original idea of the patent was that the State gave to a man a monopoly if he had produced something for the nation that otherwise would not have been introduced to the nation for at least sixteen years; but now we were trying to give a man a monopoly for producing something which somebody else would probably introduce next week if he were left alone. In that way the nuisance to manufacturers was very serious indeed. In America, for instance, a car might be produced by mass production; to alter that method of mass production was a very expensive process. By the time the car came out, the manufacturer might find that somebody had patented half a dozen little gadgets which were of no real importance, but which patents happened to cover something which had for convenience been used in the production of his car. That was a very serious nuisance, and the same sort of thing was going on in England. There was no real reason why a man who invented some little improvement such as a draughtsman was in the habit of producing every day of his life, should have a patent and be able to annoy other people with it.

MR. ROBERT BURRELL, in reply, acknowledged his very grateful thanks to Mr. Gordon and all the other speakers who had made such kind references to the paper. With regard to what Mr. Haycraft had said, he had to confess that it was somewhat news to him to know that the Patent Office was a body which regarded things with such resignation; he was also surprised to know that the Patent Office was always so prepared to do what it was told to do; in his own experience unfortunately there were many occasions on which he had asked them to do something and they had done the very opposite. Mr. Haycraft had rather suggested that the position was one of either doing or dying; the reason why he (the speaker) had supported so many suggestions in this report which imposed additional work on the Patent Office was because he had at the same time suggested that new life should be put into the Patent Office by means of vigorous reinforcements.

Mr. Gill had been rather tied, and had not been able to deal with the subject with the freedom with which, of course, he would have dealt with it had that not been so. He had, however, referred to the question which excited most interest in the report, namely, the question of short-term patents. He (the speaker) had received information from one source as to the way in which the *Gebrauchsmuster* were regarded in Germany; another speaker had then said that his information was quite the contrary; it seemed to him, therefore, obvious that the one thing they should certainly do before they went any further was to find out definitely what was the position in Germany. Mr. Gill had rather suggested that the system must necessarily be a good one because it was growing; but that did not follow. If the danger were becoming increasingly recognised, it might be that people would apply for more *Gebrauchsmuster* in order to defend themselves perhaps more vigorously than they would before. It did not follow that because a large number of *Gebrauchsmuster* were applied for they were necessarily useful. Mr. Kilburn had referred to the suggestion which he (the speaker) had made that there might

be international difficulties arising out of *Gebrauchsmuster*. What he had in mind was that this system might be established in a large number of countries. Some countries regarded their industrial property systems as a means of levying taxes; if it were seen that 51,000 *Gebrauchsmuster* were being applied for annually, it was always rather a temptation to use that method to supply the Exchequer with a little ready money. If that system were adopted in a large number of countries difficulties would arise, because at the present time a manufacturer who had to protect himself in the ordinary way by patent, protected himself in a large number of countries; if he had an obvious variation which did not involve any invention, e.g., a commonplace addition to his machine, he did not worry to search all the files in foreign countries to see whether he could send that altered machine into a foreign country without infringing a patent. But if these short-term patents could be taken out in every country, it became a very serious matter; 51,000 of these short-term patents might be issued every year in each country; in seven years that would mean that there would be about 350,000 of these *Gebrauchsmuster* in any one country to be searched before any manufacturer could be certain that he could send his machine to that country.

He desired to express his gratitude to Captain Hume, because, as secretary of the British Science Guild Committee, he had been largely responsible for the lucidity with which the recommendations were stated. Dr. Arthur Haydon had suggested that it would be desirable to put into the Act some definition of what would constitute a patentable invention; that suggestion was to some extent met by the report of the British Science Guild. He had not time to deal with the particular question which Dr. Haydon had in mind, but that raised another defect in our patent law, or at least drew attention to a Section of the Act which required further consideration, viz., Section 38A, which dealt with patents for foods, and so on. It might very well be considered whether the word "special," having regard to a recent decision, should not be removed from that Section. He did not know whether Mr. Towler's suggestion, that there was no consideration for a patent with regard to a biological invention, was strictly true. If an inventor showed an agriculturist how he could produce a rustless wheat, one would have thought that was of some use; he appreciated the difficulty of which Mr. Towler spoke, but would have thought that that might have been overcome by claiming not the first seed but the second. The Chairman had somewhat criticised the suggestion that the Comptroller should deal with patent actions, and suggested that we ought to be congratulated on the present state of things; but if it was desirable to have a lawyer as Comptroller, then if he were given judicial functions that was the very best way of ensuring that the next appointment when it took place, would be that of a lawyer, and of one who had the particular capacity to which the Chairman had referred.

The Chairman had been the only speaker who had dealt with the question of working of patents in the countries in which they were protected. He (the speaker) had feared he would be treading on many corns when he suggested the abolition of the working clauses; it had been rather a surprise to him to find that only one speaker had referred to that matter, and that speaker had been inclined to favour it. On the question whether it was a form of protection he was not prepared to go so far as the Chairman; but whether protection was a good thing or a bad thing was a matter quite apart; the point was that there was a tendency to prostitute the industrial property laws of this country for protection purposes. If protection were a good thing it should be secured by proper means and not by industrial property law.

He wished to thank the meeting for the kind way in which they had received the paper.

THE CHAIRMAN proposed a hearty vote of thanks to the author for his paper, which was carried unanimously.

MR. A. P. THURSTON, D.Sc., M.I.Mech.E., F.R.Ac.S., writes.

I did not have the opportunity of reading before the meeting the very interesting paper of Mr. Robert Burrell or of joining in the discussion, but the subject of the paper is of such great interest that I should appreciate the opportunity of making a communication.

The chief criticism against the paper appears to reside in the fact that sufficient regard has not been paid to the rights of the inventor and to the fundamental object of the British Patent Law, which exists for the purpose of improving the arts and the manufactures of the realm by encouraging the inventor and thereby raising the standard of living of the whole nation. It is not for the purpose of enabling large vested interests to acquire new inventions for nothing or a few pounds and then to hold the nation to ransom for enormous sums under patent monopoly, as may be done at present. Neither is its object to enable the use of obsolete, inefficient, or out-of-date processes to be continued by suppressing more efficient and improved processes.

The object of the Patent Law is to reward ingenious men for contributing the product of their own brains, their own intellectual property to the starting of new arts and manufactures. This side of the question, which seems to be of immense importance from the point of view of prosperity of the country as a whole and the cure of unemployment in particular, appears to have received little or no attention in the paper. Under the existing Patent Law it is possible for an inventor to communicate his invention to Government Departments, various manufacturers, all in confidence, to be discouraged by the rebuffs which he receives, and to drop his patent, then it is possible for someone else, who has probably heard of his invention, to patent it and to obtain a perfectly valid patent for the identical invention and large sums of money from the Government and public at large.

The Law is so heavily weighted against the inventor who is not also a wealthy man, and against the start of new industries, that the manufactures of the realm are being retarded in a most unnecessary degree.

I would venture to suggest that in drafting any proposed reform of the Patent Law, more attention should be paid to the rights of the inventor in his own intellectual property, and to the essential foundation of Patent Law, namely that it is for the purpose of improving the arts and the manufactures of the realm by encouraging and rewarding the inventor. Many of the suggestions raised in the paper are of great interest, but their discussion at the present stage appears to be unprofitable until more attention has been paid to the aspect of the question raised in the foregoing remarks.

NOTES ON BOOKS.

BRITISH FLOODS AND DROUGHTS. By C. E. P. Brooks, D.Sc. and J. Glasspoole, M.Sc., Ph.D. London: Ernest Benn Limited. 10s. 6d. net.

Floods and droughts have many times in human history spelt disaster and death and though modern conditions of life have reduced their destructive powers, they are still of great importance.

The authors of this book are well known authorities ; Dr. Brooks on climates of past times, and Dr. Glasspoole on rainfall in general. The book begins with an account of the rainfall of the British Isles, and the causes of persistent rain. These are various and seems at first sight sufficiently remote. For instance our weather depends in great measure on the intensities and changes of position of the Azores anticyclone and of the Icelandic depression, and these are influenced by still more remote factors

Chapter II is entitled " The Wet Year 1927 The Turn of the Tide ? " The question has already been answered in the negative, for, in spite of a fine summer, 1928 was a year of more than average rainfall in the British Islands. Since 1906, as the authors point out " only six out of 21 years have received a rainfall below the average " and " in 22 years we have had nearly 23 years rainfall. " But no year in the present century was as wet as 1903, " the year with two wet spells " So wet was it that in 100 years it was only exceeded by 1852 and 1872. As a whole the seventies of the last century were abnormally wet, and a chapter is devoted to them. When we go further back to " Historic Rains " we are dependent on chance records in various writers and chronicles, and the authors come to the conclusion that the period centred between 1000 A.D. and 1400 A.D. was one of excessive raininess. It seems to us that chance references of old writers to droughts and floods must be used with great care. Popular opinion of the weather is well known to be prone to excessive exaggeration, and much research may be needed before any idea can be reached of the sequence of climatic changes during the middle ages. But it is only fair to say that the authors attempt to get over this difficulty and in a note at the end of the book they give a method of calculation of " Raininess " dependent on the total number of records available, and the number of records of droughts and great rains respectively.

Two pieces of evidence of greater weight, as it seems to us, are mentioned by the authors. Mr. G. M. Meyer has studied water mills in East Kent and " has brought forward evidence of a decrease of rainfall about 1275 " ; for example in 1150 there were twelve water mills near Canterbury ; in 1550 they had decreased to five. Again in Roman times villas are " found close to the highest springs of the winter bournes, which run only in the wettest seasons, " and at Woodyates in Dorset a Roman bucket was found at the bottom of a well 60 feet above the level to which modern wells have to be sunk in the neighbourhood.

In considering droughts a chapter is devoted to each of the years 1921 and 1887 and another to the dry years of the 18th century when the dryness " was so marked and persistent as almost to constitute a different climate from that of the last half of the nineteenth and the beginning of the twentieth centuries "

In a chapter devoted to cycles of weather some indications are given of a maximum of raininess about 200 A.D., a minimum about 700 A.D., a second maximum about 1200 A.D. and a second minimum about 1700 A.D. ; but the authors warn us against a too hasty assumption of a period of a thousand years. Coming down to shorter periods seven cycles are considered, from one of 51.7 years down to one of 1.71 years. Fig. 15. combines these periodicities from 1870 to 1930 and gives the curve of actual rainfall. The two certainly give remarkable agreements, though at times they are " woefully at fault. " The curve is continued till 1930, but we are told not to build too much hope on the drop in the curve of raininess after 1928.

The question as to whether we are likely to see a recurrence of the dry years from 1737 to 1750 " is one of vast importance, for if a single dry year like 1921, falling in the midst of a series of wet years, suffices to cause grave doubts as to the

sufficiency of the water supply of London, only the pen of a sensational novelist could adequately picture the effect of a long series of dry years on the, presumably greater, London of the future." The book is thus worthy of study not only for the meteorologist and the historian, but even more for its suggestions of the profound effects that may occur in relation to modern conditions of civilization.

C. J. P. CAVE.

LUNGE AND KEANE'S TECHNICAL METHODS OF CHEMICAL ANALYSIS. Second Edition. Edited by Charles A. Keane, D.Sc., Ph.D., formerly Principal of the Sir John Cass Technical Institute, London; and P. C. L. Thorne, M.A., M.Sc., Ph.D., Chief Lecturer in Chemistry, Woolwich Polytechnic. Volume II. London and Edinburgh: Gurney and Jackson. £3 3s. net.

The second of the six volumes of this monumental work has now appeared in its revised form, and new editions of the remaining four are in active preparation. It is now about twenty years since the first edition of the first volume was published in England, and the technique of analytical chemistry has advanced so rapidly in the meantime that the need for an overhaul will not be disputed.

The treatise is so well known to analytical chemists that but little general description need be given. This particular volume is devoted to the metals, both ferrous and non-ferrous; the metallic salts (with a large special section on potassium salts); paints and pigments; and paint vehicles, japons and varnishes.

All the sections have been thoroughly revised and brought up to date, the latest English and American methods having been incorporated; and the publishers explain that the arrangement of the contents has been modified by grouping correlated industries together, so as to make the volume very largely self-contained. It is well that this should have been done, and chemists will agree that the further this principle can be carried the better: those who do not happen to be professional analysts naturally find some hardship in having to purchase several volumes of such a treatise in order to deal with some problem whose various aspects could easily have been covered in one.

The references to original papers are numerous and well chosen, while most of the sections are provided in addition with valuable separate bibliographies. The index is sufficiently full, but one is glad to note that a separate index-volume to the whole work will be issued on completion of the new edition.

OBITUARY.

HEDLEY FITTON, R.E.—Mr. Hedley Fitton, who died at his Haslemere home on July 19th in his 73rd year, was well-known as an etcher and draughtsman of architectural subjects. In his early days he was associated with the Daily Chronicle under Massingham and illustrated a number of articles by Frederic Harrison on Repair or Restoration. His work, in which atmosphere and texture, and richness of quality in light and shade were the distinguishing features, obtained early recognition both in this country and in France. He was awarded the Gold Medal of the Société des Artistes Français in 1907 and three years later became an Associate of the Société Nationale des Beaux Arts, while two of his etchings—the Rue Hotel de Ville and Ponte Vecchio—were selected from the Salon for the permanent collection at the Petit Palace. He was also elected a Fellow of the Royal Society of Painter-Etchers and Engravers, to whose exhibitions as well as to the Academy and the Salon he was a regular contributor. He had been a Fellow of the Royal Society of Arts for nearly a quarter of a century.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4003.

VOL. LXXVII.

FRIDAY, AUGUST 9th, 1929.

*All communications for the Society should be addressed to the Secretary, John Street,
Adelphi, W.C.(2.)*

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE TREATMENT OF COAL.

By C. H. LANDER, C.B.E., M.Inst.C.E., M.I.Mech.E., F.Inst.P.,

Director of Fuel Research, Department of Scientific and Industrial Research.

LECTURE I.

(Delivered 21st January, 1929.)

In this generation of scientific, technical, and industrial achievement it is difficult to imagine a world ignorant of the uses of coal, yet its exploitation on a really large scale has extended over a relatively short period. In 1800 Great Britain's annual coal production amounted only to 10 million tons, but this rose steadily to a maximum of 287 million tons in 1913, of which 189 million tons was retained for home use. Following upon an abnormal period due to war and post-war conditions, the home consumption of coal has again reached almost its former maximum level, showing slight variations above or below a mean of about 175 million tons annually, although exports have seriously declined.

The following table, taken from the Seventh Annual Report of the Secretary for Mines, shows the manner in which this coal is employed. Roughly 20% of it is treated by carbonisation industries; nearly all of the remainder is burned in its raw state, much of it for steam-raising purposes. It is evident from these figures that whatever developments of new processes the future may see, the efficient utilisation of raw coal merits close attention.

TABLE I.
CONSUMPTION OF COAL IN GREAT BRITAIN.

[illegible]

The application of the numerous types of coal to the purposes for which they are best suited entails a knowledge of their physical and chemical characteristics, a full understanding of which depends upon the elucidation of the constitution of coal. This is being sought after in several ways, including chemical analysis, microscopical examination and the use of X-rays, certain aspects of each of which will be considered briefly.

Chemical Analysis, in addition to its use for scientific requirements, has a wide field of application in connection with the buying, selling and commercial utilisation of coal. For all purposes a certain standard of accuracy is desirable. It is well known that the figures obtained by different workers for the same determination frequently show wide variations due to differences—either fundamental or of detail—in the methods employed. In order that all the results of any determination may be of the utmost value it is essential that the methods employed shall be, if not identical, at least capable of giving comparable results. In this country the Fuel Research Board, feeling that some degree of agreement upon methods was desirable, in 1921 appointed a committee to examine the whole question. The outcome of this was the publication of detailed instructions for carrying out the principal determinations involved.¹ With a view to an extension of their use these methods were brought to the notice of the British Engineering Standards Association in order that this body might consider the adoption of some or all of them as standard methods for the analysis of coal. As a result a widely representative committee was appointed to deal with the matter, and sub-committees and panels are now actively engaged in an endeavour to formulate methods which can be widely adopted for the analysis of coal for commercial purposes.

Careful analysis by such methods will, however, give results of little or no value unless the sample tested is truly representative of the bulk from which it is taken. The question of sampling is even more difficult than that of analysis. The larger the sample, up to a point, the more likely is it to be truly representative of the consignment, but the cost may then become prohibitive. A compromise has therefore to be reached in which the accuracy of the sample is sufficiently good for commercial purposes without the expense incurred in obtaining it being too great. Methods of sampling have been considered by a committee of the Fuel Research Board, and a large number of special tests have been carried out, not only at H.M. Fuel Research Station, but also at actual ports of shipment, with reference to sampling from stationary bulks, hoppers, railway waggons and ships, and during delivery from chutes, conveyors, etc. These tests included experiments in regard to the size of the increments, the size of the gross sample in relation to the quantity represented, and the crushing and reduction of the gross sample to a size suitable for the laboratory. Much data has also been received from outside parties interested

¹ Methods of Analysis of Coal. *Fuel Research Board, Physical and Chemical Survey of the National Coal Resources*, No. 7. H.M. Stationery Office (1927)

in the question. Much further information is necessary, however, before final methods for the sampling of coal under different circumstances can be formulated. In the meantime the question is being considered, as in the case of coal analysis, by the British Engineering Standards Association, all the relevant data collected by the Fuel Research Board having been placed at their disposal.

The aid of the microscope has also been enlisted in the examination of coal, the aims being to determine the botanical nature of the original material and the nature of the physical and chemical changes which accompanied its transformation into coal, and to correlate this information with the properties of the surviving material. This was rendered possible by the beautiful technique developed by Lomax, who was one of the first to succeed in preparing sections of coal sufficiently thin to be examined with ease by transmitted light. The important question of the identification and correlation of coal seams is also being investigated by the application of microscopical methods.

Thiessen,^{*} in America, applied microscopic methods to coal when, in attempting to discover the cause of the differences between caking and non-caking varieties, an exact knowledge of the origin and composition of coal became necessary. For this work he employed thin (translucent) sections and polished but unetched surfaces. Thiessen recognised three components in ordinary bituminous coals—bright coal, dull coal and the so-called mineral charcoal; the last occurs usually in very thin laminæ, the first two components constituting the bulk of the seams. To the bright and dull coal he gave names indicative of their origin: the bright coal, each lenticle of which he considered to be derived from a single portion of a coal-forming plant or tree, he called anthraxylon; the dull coal, composed of finely-comminuted plant debris—a kind of botanical mud—he called attritus. In passing it may be stated that recent evidence appears to show that some bright bands may also be derived from debris.

It is essential for complete knowledge of a coalfield to be able to trace which seam is which over the whole area. Frequently this can be effected by geological means alone, but Thiessen and his collaborators^{*} have employed microscopical examination to assist in the correlation of coal seams. They showed that different seams contain different assemblages of spore-exines (the outer coats of the reproductive elements of non-flowering plants), and have succeeded in correlating certain seams by the recognition in them of characteristic microspores.

^{*} Thiessen, R., Structure in Palæozoic Bituminous Coals, *U.S. Bureau of Mines Bulletin* 117, 1920.

^{*} Thiessen, R., and Voorhees, A. W. A Microscopic Study of the Freeport Bed, Pennsylvania, *Carnegie Institute of Technology, Bulletin* 2, 1922.

Thiessen, R., and Staud, J. N. Correlation of the coal beds in the Monogahela Formation in Ohio, Pennsylvania, and West Virginia, *Carnegie Institute of Technology, Bulletin* 9, 1923.

Thiessen, R., and Wilson, F.E. Correlation of coal beds of the Alleghany Formation of Western Pennsylvania and Eastern Ohio, *Carnegie Institute of Technology, Bulletin* 10, 1924.

The significance of spores for correlation purposes has been studied in Europe by Lomax, Lange, etc.,⁴ and by members of the South Yorkshire Fuel Research Staff of the Department of Scientific and Industrial Research.* The latter have also investigated the distribution of spores in certain Yorkshire seams. By means of thin sections representing the seam from floor to roof the megaspores have been classified, and the number of each type in the different sections has been recorded. The results so far obtained indicate that, even when no single distinctive megaspore characterises a seam, the relative concentrations at different horizons may be utilised for correlation purposes.

The constitution of coal has been the subject of a considerable amount of microscopical work. Stopes,⁶ in a paper published in 1919, rendered the distinctions between bright and dull coal more definite by the introduction of four terms based upon the physical characters of the banded constituents. These terms—vitrain and clarain for two types of bright coal, and durain and fusain for two types of dull coal—have been widely adopted in Europe, though not without some uncertainty as to their meaning, due to attempts at correlation with terms based upon botanical considerations, such as the anthraxylon and attritus of Thiessen previously mentioned. Stopes' definitions were based primarily upon macroscopic features, and although she gave an indication of the microscopic characters of the constituents the establishment of these must be the task of later investigators.

C. A. Seyler, of Swansea, has made a notable contribution to this aspect of the work in developing the technique of the metallographic method first applied to coal by Winter. Specimens are ground flat, polished and etched, and examined under the microscope by reflected light. By this method Seyler has shown that plant structures in coal are more numerous than was previously supposed, and that vitrain—originally considered by Stopes to be structureless—may contain traces of plant remains. Moreover, lenticles of both vitrain and clarain—the bright constituents of coal, together corresponding to Thiessen's anthraxylon—are not necessarily derived from single plant fragments, as Thiessen asserts, but may originate from plant debris. Seyler has also shown that, sometimes in a single plant fragment, well-defined structures may pass by various stages into a nebulous state, becoming obscured and finally lost.

A further advantage of this method of examination is that, in order to determine the true nature of plant remains, specimens can be examined in three planes at right angles by preparing three surfaces in those directions. By this means it is possible in some cases to assign a fragment to the particular

⁴ Lange, Th., Die Bedeutung der Sporen für die Stfatiographie des Karbons, *Zett. Oberschles. Berg. u. Hüttenmänn. Ver.*, 1927, 66, 340.

⁵ Evans, M. M., Correlation of the Parkgate Seam: a Preliminary Study, *Trans. Inst. Min. Eng.*, 1926, 71, 451.

⁶ Stopes, M. C., On the Four Visible Ingredients in Banded Bituminous Coals. Studies in the Composition of Coal, No. 1. *Proc. Roy. Soc.*, 1919 (B), 90, 470.

genus, or even species, to which it belongs' and it would thus appear that the method may perhaps be applicable to the correlation of seams.

Kellett,⁸ working under the direction of Professor G. Hickling of Armstrong College, employs the microscope to trace the vertical and lateral variations in the ash contents of certain coal seams of Durham and Northumberland. By means of series of thin sections cut from pillar samples representing the entire thickness of the seams, and by chemical analysis, he has recorded the variations in the percentage and nature of the ash. The preliminary investigations have shown that the distribution of the ash and of the banded constituents may be characteristic of a seam, and attention has been turned to correlation by this method.

The application of X-rays to the examination of coal, the first recorded example of which occurred as long ago as 1897, has in recent years been taken up by many workers, in this country, notably by C. N. Kemp.⁹ This line of investigation is concerned with the study of the ash in coal and depends upon the differences in transparency to X-rays of the organic coal substance and the inorganic ash constituents; the latter, being relatively non-transparent, are seen in marked contrast in the resulting radiograph. From the results so far obtained it seems probable that, with improved technique, the method should provide a rapid means of determining the distribution, nature and amount of the ash in coal; while, with the aid of stereo-radiographs, it should be possible to study in detail the structural characteristics of the ash.

Much of the work described was assisted by grants from the Department of Scientific and Industrial Research.

The foregoing illustrates some of the more important scientific methods which have been adopted in recent years to give a closer knowledge of the coal substance. The necessity for such information increases with the complexity of the process to which it is intended to subject the coal, but when it is to be burned in its raw state many of the details referred to are not of primary importance. In this case the calorific value must be known, since it is a measure of the maximum energy obtainable; also the ash content and the fusibility of the ash, since these determine the amount of inert material and the precautions which must be taken to deal with the slag. The moisture content of a coal is of obvious significance, and some knowledge of its caking properties is needed since these determine its behaviour in various types of grates. The volatile matter also affects the design of furnaces for smokeless combustion and efficiency, and limits to some extent the applications feasible. All these factors can be determined by relatively simple methods.

⁷ Seyler, C. A., On the Dictyoxylon Cortex of Lycopodiales as a Constituent of Coal. *Phil. Trans. B.*, 216, 353.

⁸ Kellett, J. G., The Physical Constitution of Bituminous Coal and Coal-seams, *Trans. Inst. Min. Eng.*, 1928, 75, 400; and The Distribution of Ash in Bituminous Coal-seams, *Trans. Inst. Min. Eng.*, 1928, 75, 413.

⁹ Kemp, C. N., The X-Ray Examination of Coal Sections, *Proc. Roy. Soc. Edin.*, 1928, 48, 167.

Coal is a highly complex organic substance made up mainly of the elements carbon, hydrogen, sulphur, oxygen and nitrogen ; and coal and its derivatives are of great importance in the chemical industries, since they provide the raw material for the manufacture of a wide range of commodities, indispensable to modern civilised life, such as dyes, drugs, disinfectants, fertilisers, etc. Nevertheless, an overwhelming proportion of the world's vast output of coal is used mainly by virtue of its energy content, for the production of heat, power and light. It is thus essential that as large a proportion as possible of the heat units in this coal should be released and subsequently utilised for the required purposes, and the most direct measure of the value of appliances for heat production is the " efficiency ratio " of heat utilised to potential heat in the coal burned.

Although of considerable significance, such thermal efficiency figures do not always run in line with true commercial efficiency, which is controlled by a variety of factors other than the mere proportion of heat utilised in a process, and must take into account a complete range of operations. It is concerned not only with thermal energy, but also with the materials, labour and appliances necessary to clear a site, erect and equip a factory with the requisite heat-producing and other apparatus (capital costs), and to carry out the manufacturing processes involved (running costs). Rates and transport charges must also be taken into account.

If the generation of a maximum quantity of heat, without regard to its form or application, were the sole aim, the best method of utilising coal would in most cases be to burn it directly in its raw state, since in this way it is possible to liberate a higher proportion of its constituent heat energy than can be obtained through any system of pretreatment. But because it allows of a more efficacious application of the heat produced, or because it influences favourably some extraneous factor, pretreatment may none the less in a large number of cases be advantageous.

In the earlier methods of heat and power production coal was always fired by hand. With careful and intelligent stoking surprisingly good results can be achieved by this primitive method, but in addition to introducing a troublesome element of human unreliability, hand-firing suffers from inherent losses and disadvantages consequent upon its intermittent nature. Thus during the stoking periods the increased access of air causes a cooling down of the furnace which not only results in smoke production, increased flue losses and decreased efficiency, but also makes uniformity of working impossible of attainment. By rendering the process of firing mechanical, much has been done to improve the efficiency of boiler firing units.

The chief problem in burning coal is to bring the fuel into intimate contact with a sufficient quantity of air for its complete oxidation. In practice the difficulty is illustrated by the necessity for supplying a quantity of air in excess of that theoretically required for complete combustion, which yet is

not able to prevent completely smoke production and the escape of potentially useful unburned products up the chimney.

In gaseous fuels, since each particle of combustible matter is in the molecular state, it is comparatively simple to secure such intimate mixing as will allow of every molecule being brought rapidly into contact with the oxygen necessary for its combustion. Liquid fuels similarly, by vaporisation prior to combustion, can be given free access to air, but since the molecules of a liquid are much more complex than those of a gas, the process of burning is less direct. The primary considerations in oil burning appliances are thus the evaporation of the oil and its subsequent contact with sufficient oxygen. With the heavier oils mechanical "atomisation" is necessary in order that vaporisation may proceed rapidly and efficiently.

In solid fuels, the aggregations of molecules are enormously larger than those of liquid or gaseous fuels. When one imagines a piece of coal lying on a furnace bed with only its surface molecules exposed to air, and with the air supply contaminated by inert gases, it is indeed a matter of some surprise that such high efficiencies can be obtained in practice.

Consider the principal combustibles, carbon and hydrogen. These can exist either separately, or in enormous numbers of different combinations, either gaseous, liquid or solid, at atmospheric temperatures and pressures. Some of these, although liquid or solid at atmospheric temperature, can be gasified under an increased temperature, but we may have aggregations of solid molecules which cannot be gasified by the action of heat alone to molecules of the same composition. Coal falls into the latter class.

It is only in the simplest compounds, such, say, as carbon monoxide and hydrogen, that it is possible to imagine that by thorough mixing each molecule can be brought adjacent to the necessary molecule of oxygen for its complete combustion, so that they may combine immediately the temperature of the mass is raised to such a degree that chemical combination at an appreciable rate is possible. Given such an intimate mixture of simple molecules it is possible to imagine combustion taking place without any further circulation of the molecules being necessary. The case of burning, with high flame temperature, of water gas, which consists of approximately equal parts by volume of carbon monoxide and hydrogen, is due to this. As soon as the molecule becomes more complex, such as methane or ethane, it is no longer possible for all the atoms composing it to be so favourably placed in relation to the oxygen molecules that they can immediately pick up the oxygen necessary for combustion, but relative motion must take place between the molecules of the combustible gas and the oxygen, so that the atoms forming the methane molecule may make contact with the four atoms of oxygen necessary to attain complete combustion. Although relative motion is necessary, in such an example as that quoted the degree of so-called turbulence required to effect rapid combustion need not be very great. But as the mole-

cules increase in complexity we see that in addition to their being intimately mixed initially, relative motion of constantly increasing amount is required between combustible molecules and oxygen molecules, to ensure rapid combustion and the attainment of maximum flame temperature. Further, in the more complex molecules Professor Bone has shown that combustion proceeds by a series of successive reactions between the atoms of the molecules themselves and the oxygen atoms within reach, with the formation of intermediate compounds before the final oxidation to carbon monoxide and water.¹⁰ If at any stage in the reaction the partially split molecule finds itself out of reach of the necessary oxygen, hydrocarbons or carbon may be formed which are more difficult to burn quickly, and tend to increase of soot formation. If we imagine a single molecule to be surrounded by the necessary number of molecules to burn it, the latter will obviously occupy a larger and larger space as the combustible molecule becomes more complex, so that the more complex the molecule the longer the relative path which it must move through before it can have picked up all the oxygen for complete combustion.

When we come to the burning of solid particles of even the smallest size that can be produced by pulverisation, each aggregation of molecules is so concentrated that even when each particle of combustible is at the centre, say, of a sphere containing all the necessary oxygen molecules for complete combustion this sphere will at atmospheric temperature be about 23 times the diameter of the particle or 12,000 times its volume. At 2,500° F. these figures become diameter 39 times, volume 60,000 times, and the relative travel of combustible to oxygen will necessarily be vastly greater than that necessary in the case of the simple mixture of two gases however complex the molecule of the combustible gas may be. We therefore get from the burning of, say, carbon monoxide to the burning of a 300-mesh particle of carbon a complete inversion of the relative importance of intimate mixing as such, and relative velocities of the molecules. In the former case intimate mixing is of paramount importance, in the latter relative velocity is everything. A lump of carbon lying on the grate of a boiler may eventually be completely consumed by a large volume of air, by bringing oxygen molecules in succession into contact with the surface of the coal. When gases are evolved, mixing, of course, takes place, but intense combustion so as to obtain maximum temperature can only be accomplished by a rapid velocity of air along the surface of the coal.

These considerations, elementary as they are, explain the developments which have taken, and are taking, place in the manner of burning powdered coal, and afford a reason for the success of the so-called turbulent burner. Turbulence as such is, however, an uncontrolled way of attaining relative motion between coal and air particles, and involves a breaking up of stream lines. What is needed is to obtain as stable and streamline a form of motion of the air as is

¹⁰ Bone, W. A., "Coal and its Scientific Uses," Chapter X. (Longmans, 1918).

possible, and induce the particles of combustible to move from one stream-line to another in as controlled a manner as possible. During recent years burners and furnaces (for the latter are of equal importance with the former), have gradually tended towards getting a better control of this relative motion, but mathematical analysis of the problem shows that much more is possible and that the limit to the amount of heat release which can be obtained in a furnace of given volume is only governed by the impossibility of obtaining furnace materials which will stand the drastic action to which they may be subjected. Recent years have seen reductions in combustion volumes, and the application of powdered fuel to the furnaces of Scotch boilers which a few years ago was considered impossible. An extreme case of limitation of furnace volume occurs in the locomotive, but although some success for pulverised fuel is claimed even in this field, the small volume of the furnaces still presents great difficulties. The writer is confident, however, that eventually it will be possible to utilise powdered coal in locomotives with high efficiency; but this will not occur until the design of both furnace and burner is such as to incorporate the principle of a controlled motion of the particles relative to or across the stream-lines of the gas, with the abandonment of the idea that uncontrollable turbulence is all that is required.

Since the simple molecules carbon monoxide and hydrogen can be induced to burn rapidly by mere intimate mixing, the problem of burning materials of great molecular aggregation would probably be simplified if the portion of the consuming appliance dealing with the solid particles could be reduced to a minimum, since this portion of the apparatus is the one where high relative velocities between particle and air are needed to get high stream-line interchanges. As soon as the particles have been reduced to the gaseous form, whether by physical changes alone in liquid fuel, or by chemical changes in solid fuel, the high velocity factor becomes less important and mainly induces rapid mixing. It would thus appear that the function of that portion of the apparatus dealing with the solid material could best be reduced to the delivery as end product of producer gas. The remainder of the furnace would not then require the refinements of design necessary to ensure the maximum degree of stream-line interchange. Also the temperature involved in the burning of carbon to carbon monoxide is considerably less than that involved in burning of carbon to carbon dioxide; and on account of the smaller heat release the provision of refractory material, or the cooling of metallic walls, becomes of much less importance. The temperature might possibly be reduced to such a degree as not to fuse the ash.

The combustion of solid material must always suffer from the disability that, unlike even the heaviest oil particle, coal cannot be immediately vapourised; but it can, nevertheless, be brought by pulverisation into a state in which the surface exposed to the action of air is enormously increased over that of the lump, or even of the slack, form although, even with the finest pulverisation

attainable, the particles still remain large compared with chemical molecules. For instance, by grinding a piece of coal 1 inch cube so finely that it will just pass through a sieve containing 300 meshes to the inch, the total exposed surface of the resulting particles is increased to 300 times that of the original single lump of coal ; but the relation which the mass of each of these particles bears to the mass of a molecule, say of methane, is still about the same as the mass of a lump of coal the size of the earth would bear to a lump of about 25 yards.

Pulverisation alone, however, as we have already seen, does not afford the key to complete combustion ; a lump coal, for instance, will burn more easily than a slack, a slack coal more easily than a bed of dust. It is necessary, having obtained through pulverisation the maximum feasible increase in surface area, to ensure the contact of the exposed area with oxygen. The first stage in the process is usually to bring a cloud of the finely-divided particles into suspension in air. When the ratio of combustible matter to air is properly proportioned—between fairly wide limits—such clouds become highly inflammable, and indeed have been the cause of some of the most disastrous colliery explosions on record. The above considerations are so obvious that it is not surprising to find that Niepce experimented with pulverised fuel more than ten years prior to the advent of the first mechanical stoker. (Wm. Bruton, 1819.)

From hand-firing to mechanical stoking, however, was a comparatively simple step ; the conditions consistent with success in hand-firing were fairly well known, even at that early date, and the problem presented was one only of the application of known principles. All that was necessary was to ensure that in the substitution of mechanical firing devices the necessary provisions for satisfactory combustion should be retained. A very different state of affairs prevailed in regard to the utilisation of coal in the powdered form, extended research work having to be undertaken before its commercial development became at all feasible.

Space would not allow of a full account of the gradual progress of powdered fuel. During the period already referred to, sporadic attempts were made to apply it in the metallurgical field, especially for the production of iron, as well as for heating brick kilns and for glass manufacture. It may be worth noting, however, that in 1877 the *Engineer* reported the application of pulverised fuel to a Cornish fire-tube boiler, an evaporation of 8.3 lb. water per lb. of coal being claimed. This boiler appears to have worked for some time, but was eventually shut down owing to the high cost of pulverisation, and probably also from lack of knowledge of proper furnace design for pulverised fuel. The many problems involved in the burning of pulverised fuel in a minimum volume cannot yet be said to have been completely solved, but progress has been so rapid that it has already found most interesting applications to tank boilers, such as Lancashire or Scotch marine boilers.

Since pulverised fuel lends itself to the production in simple appliances of long flames, it is perhaps natural to find its first commercial success in rotary kilns for cement burning. It was first experimented with for such purposes about 1895 and has now largely superseded other forms of fuel. The particular requirements of this industry are such that full advantage can be taken of the best features of firing with pulverised fuel, while its more doubtful points are of little significance. Long flames can be fully utilised without being subjected to any considerable cooling effects. The lining of the kiln may suffer from the action of the ash, but the disposal of the ash causes no difficulty, since its presence in the final products can be allowed for by adjustment of the relative quantities of the raw materials.

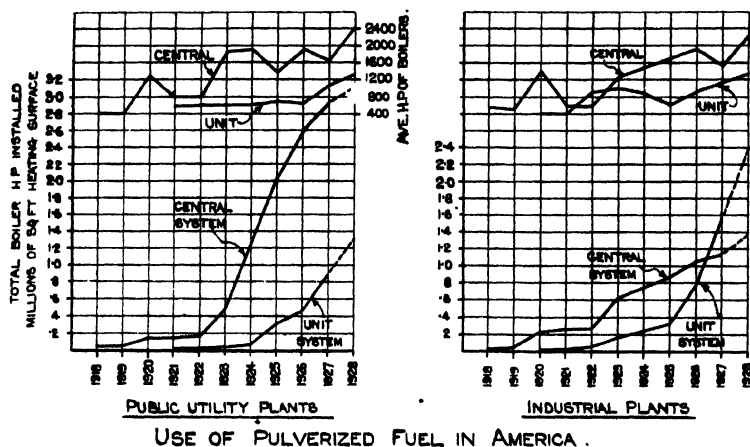


FIG. 1.

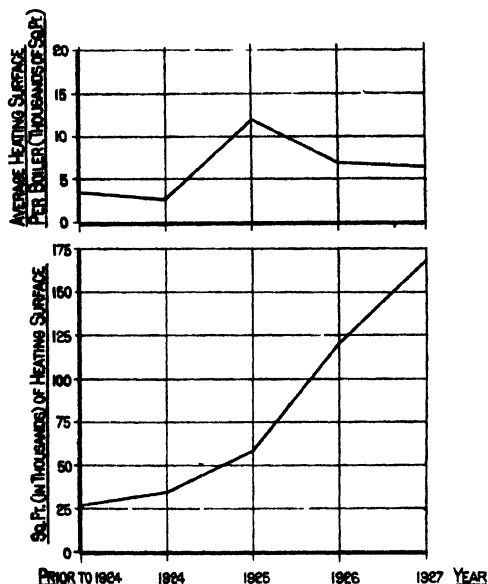
The earliest successful application of powdered coal to boilers is usually credited to Bettington, who, as the result of experience with powdered fuel cement plants, designed an upwardly fired vertical boiler with a burner at the bottom of the firebox and water-cooled furnace walls. Troubles were experienced through slag formation and the slagging up of the vertical burner nozzles, but some of Bettington's installations are still in operation.

So long as pulverised fuel was applied only to furnaces such as cement kilns where the long flame could be injected coaxially with the furnace, and where large furnace volumes with comparatively low values of heat release per unit volume were sufficient, the problem remained comparatively simple; and, generally speaking, success is much easier of attainment where large combustion chambers can be provided, as in many types of water-tube boiler, than in appliances where more restricted conditions obtain. Much progress has been accomplished during the past decade, and, particularly in America,

there has been a rapid development of pulverised fuel firing in large water tube boilers for central electricity generating stations and similar installations.

With pulverised fuel complete combustion can be ensured with relatively low air supply, and high working efficiencies can be maintained. Flexibility is a further advantage of pulverised fuel installations; fires can be started at very short notice, and response to changing load requirements is rapid. Further, the plant can be operated successfully on a wide range of coals.

Fig. 1, which has been adapted from a Report of the Pulverised Fuel Subcommittee of the U.S. National Electric Light Association (1928) shows the total heating surface in millions of square feet served by unit systems and central storage systems installed in public utility plants and industrial plants



THE USE OF PULVERIZED FUEL IN ENGLAND

FIG. 2.

in the U.S.A. at the end of each of the past ten years. The curves show a rapid increase not only in the total boiler horse-power installed, but also in the average horse-power of pulverised fuel boilers. The increasing popularity of the unit system of firing is evident, particularly in the case of industrial plants.

Data given by Rosencrants¹¹ and illustrated in Fig. 2 show a simultaneous

¹¹ Rosencrants, F. H., "Pulverised Fuel Firing," *World Power Conference, Fuel Conference 1928, Section M.*

increase in pulverised fuel systems in England ; but in 1927, the latest year for which comparisons are available, while the total boiler horse-power installed in public utility and industrial plant in the United States amounted to 6½ million square feet of heating surface, in England it had reached only 2 or 3 per cent. of this figure.

The centralised system, in which coal is first dried and then ground in a centralised plant from which it is delivered by piping or other suitable arrangement to all the boilers of the station entirely held the field until about 1923. About this time there were introduced both in Great Britain and America, small self-contained pulverisers, each designed to feed its products directly to its own separate boiler. Prior to the advent of the unit pulveriser it was not usually economical to adopt pulverised fuel firing on other than a very large scale, and even at the present time by far the greater proportion of pulverised fuel is consumed in a relatively small number of very large installations, most of which utilise the central system.

So far as Great Britain is concerned, the practical application of pulverised fuel is still in its infancy, but in America over 25 million tons of coal were consumed in this form during 1928. This was distributed roughly as follows :—

Boilers	...	...	...	...	11 million tons.
Cement	...	...	...	...	6 " "
Metallurgical furnaces	...	...	...	...	3 " "
Copper smelting	...	...	...	...	2 " "
Miscellaneous	...	...	...	...	3 " "
					—
Total	...	...	...	...	25 " "
					—

The total amount of this pulverised coal was about equally divided between direct and storage systems, although in point of number the unit installations, particularly in industrial plant, greatly exceeded the central installations, showing that the former system is applicable mainly to small scale plant. For boilers of really large size the central system still holds the field, but the unit system, which although probably slightly less efficient than the central system is lower in capital cost, appears also to be obtaining a footing. Whether or not its development for large scale work will continue, it is impossible to forecast, since efforts are being made to reduce the capital cost of the centralised system by careful design and by such means as the elimination of coal dryers, etc. It is probable also that the apparent overtaking of the centralised system by the unit system is due in some degree to the fact that at the moment unit systems are fashionable, and many unsuitable applications, which may tend later to cause a set back, have been made. Unit mills have been used with boilers as small as 16 feet by 5½ feet, or about 100 h.p. nominal rating, efficiencies of 74% to 75% having been reached. For metallurgical and copper work central systems are employed almost exclusively. In large scale powdered

coal installations very high efficiencies of steam raising, say 80% to 90%, can be maintained. It is also claimed that owing to the general application of water or steam cooling of the combustion chambers of pulverised fuel plant, maintenance costs, especially repairs to furnace refractories, are relatively low, while stoppages due to breakdown are minimised. On the other hand it must be remembered that modern practice has made possible almost equally high efficiencies in stoker-fired boilers.

When a relatively new development is advocated, and adopted as an alternative to established practice, it often happens that incidental improvements of design, equally applicable to the other methods, can be incorporated in the new plant, giving it an apparent overall advantage to which it is not altogether entitled. On the other hand, costly but advantageous elements of design in the new plant, which would be equally necessary in older designs if maximum efficiency were looked for, may unfairly be accounted drawbacks.

Among the former may be cited the adoption of water-cooled walls where high rates of burning pulverised fuel are necessary. For similar performances such cooling is equally necessary with mechanical stokers, but has developed far more rapidly in connection with pulverised firing as a means of obviating the enormous furnace volumes which have hitherto been required to avoid the destructive effect of the impinging of flames, or of intense radiation on the furnace walls.

The large combustion volumes apparently needed for burning pulverised fuel have in the past tended to react against it, and the figure of 25,000 to 30,000 B.Th.U. per cubic foot per hour of heat release adopted by designers of pulverised fuel furnaces, were compared with the 80,000 to 100,000 B.Th.U. of the mechanical stoker furnace. This latter figure had, however, been adopted as a compromise between the enormously increased capital cost associated with furnace volume increase in a stoker fired installation and the saving due to more efficient combustion. Actually theory would indicate that the pulverised fuel furnace for equal consumptions really requires volumes less than those required for stoker firing. Much experimental work has been carried out to find the conditions necessary for combustion in the minimum volume. Audibert, in France, burned pulverised coal in a tube furnace with various velocities of air up to those where an undulating motion corresponding to the properties of the tube were attained. When this vibration was attained a rapid increase in speed of combustion was observed, and the flame shortened to half its previous length.

Several years ago some experiments were carried out at the Fuel Research Station on burning coal in the simple circular furnace shown in Fig. 3. As a furnace the experiments were not entirely successful but the results showed quite clearly that coal could be burned in spaces much less than had been considered necessary up to that time. The figures given in Table II show some of the preliminary results obtained during a test designed to gasify the fuel

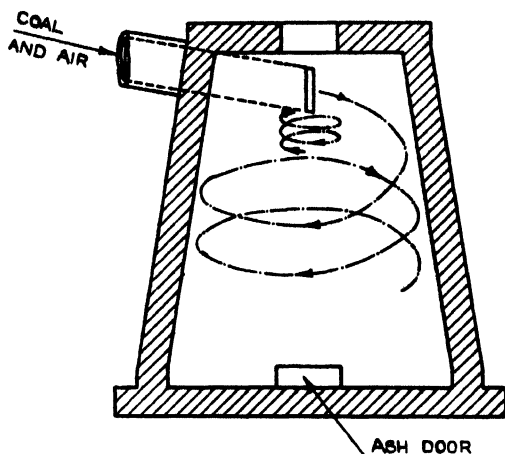


FIG. 3
Experimental Pulverised Fuel Combustion Chamber
at Fuel Research Station.

only. The heat release amounted to 90,000 B.Th.U. per cu. ft. as against the designing figure of say 27,000 B.Th.U.

TABLE II.
TYPICAL FIGURES OBTAINED IN EXPERIMENTAL PULVERISED FUEL
COMBUSTION CHAMBER.

Volume of chamber	=	20 cu. ft.
Feed of coal	=	420 lb./hr.
B.Th.U. in coal	=	4,400,000 B.Th.U./hr
B.Th.U. in solid fuel projected from chamber with gas.	=	790,000 B.Th.U./hr
Heat liberated in chamber	=	1,810,000 B.Th.U./hr
Potential heat leaving chamber in producer gas (c.v. multiplied by volume)	=	1,800,000 B.Th.U./hr
Heat liberated in chamber per cubic foot per hour		
$\frac{1,810,000}{20}$	=	90,500 B.Th.U.
Temperature of combustion chamber walls	=	1220° C.
Percentage of ash in coal	=	25 per cent.
Percentage of total ash deposited in chamber	=	30 per cent.
Velocity of coal and air stream entering chamber	=	110 ft./sec.
Inclination of stream at entry to horizontal	=	15°

Probably the highest figures so far reached are those quoted by Brookes in a paper read before the Engineers' Society of Western Pennsylvania in 1925. An attempt was made to simulate the action of the tornado in the furnace illustrated. (Fig. 4.) For details of this work reference should be made to Brookes' paper, but it is interesting to note that the enormous figure of 1,100,000 B.Th.U. per cu. ft. per hour was obtained. By the adoption of a similar principle reductions have been made in the furnace volumes of

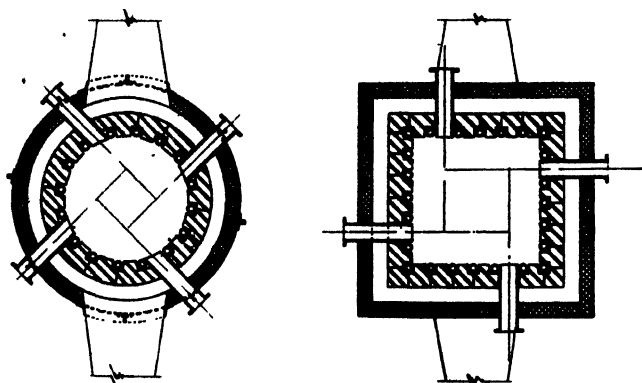


FIG. 4.

Experimental Pulverised Fuel Furnace simulating tornado action.

"well" type furnaces, and several installations of a design based upon this experimental work are in operation in the U.S.A. It would not be possible, however, with material available at the present time to approach in practice anything like the figures obtained by Brookes, who considers that 100,000 B.Th.U. is probably the practical limit at present.

A point of difference between stoker fired and pulverised fuel fired furnaces which has always given trouble is ash disposal. When a bed of coal burns on a firegrate the ash tends to settle to the bottom through the bed, and finally to find its way directly into the ashpit without ever having entered the actual combustion chamber. In pulverised fuel firing the ash is injected into the combustion chamber in a finely divided state in association with the coal. So long as pulverised fuel furnaces remained comparatively small in size no great trouble was experienced. The furnace temperature was not usually high enough to fuse the ash which was ejected in fine discrete particles through the smoke stack, but with larger installations this method of ash disposal tended rapidly to become a public nuisance. A boiler installation consuming 1,000 tons of coal per day, for instance, and ejecting half its ash by way of the smoke stack would, if burning a coal of 10% ash content, deliver into the air 50 tons of ash daily. This ash, unless carried away rapidly by winds, would tend to settle upon the surrounding property. Naturally, therefore, many bitter complaints have arisen from residents in the neighbourhood of pulverised fuel plants. The trouble has been partially overcome by the provision of higher chimneys, by cyclone or other dust catchers at the chimney base; or in one or two instances, the Lodge-Cottrell system of electrical ash precipitation has been installed.

In the earlier types of British pulverised fuel furnaces, where air cooled refractory walls only were used, and greater intensities of combustion attained,

molten particles of ash tended to fuse on to the wall and rapid deterioration of the refractory took place. According to Rosencrants, with modern completely water cooled walls the fused particles do not attach themselves very firmly to the walls, so that after a time the weight of the accumulated lumps causes them to loosen and fall down. In some types of furnaces under development in America, the ash is definitely fused to slag and is caused to run down into a slag pit at the bottom, from which it can be extracted from time to time.

In marine application, an important point is to prevent the ash from settling down on the decks. It is understood that trouble was experienced in the earlier voyages of the S.S. Mercer through this cause, but this vessel had unusually low smoke stacks, and the writer is informed that the trouble has now been obviated by lengthening the stacks.

The application of pulverised fuel to marine purposes is exceedingly attractive in a country which has no indigenous supplies of natural oil. The full advantages of oil firing are not likely to be obtained by pulverised fuel but it is very probable that many of them can be realised. The first successful pulverised fuel ocean-going steamer was the above mentioned S.S. Mercer belonging to the U.S. Shipping Board. Troubles of a minor type were experienced during the widely advertised first voyage when the vessel reached Rotterdam in December 1927. The ship is still in commercial service using pulverised fuel and in November 1928 had completed her 6th voyage without having once been behind schedule in spite of minor troubles. At the present time the U.S. Shipping Board are investigating a very attractive form of pulveriser in which, instead of there being one pulverising mill for one, two or even three boilers, a small complete installation of pulveriser, fan and burner is fitted to each furnace of a Scotch boiler. The author had the privilege of seeing this test installation at the Philadelphia Test Navy Yard in November last, and was impressed with the simplicity of the apparatus and the excellent results which were being obtained. It is understood that the Shipping Board are at the present time fitting a vessel which will be fired entirely with this type of equipment.

In Great Britain, useful work is going on in several directions, the voyage of S.S. Stuartstar with unit equipment of the Woodeson type being especially interesting. A new ship, the Berwindmore, is being equipped to burn pulverised fuel and half the boilers of the New Zealand Shipping Company's vessel Hororata are being tried with the Howden Buell system.

In some of the earlier experimental work carried out during the War, auxiliary combustion chambers were built outside the boiler. The present method, which is likely to render pulverised fuel for marine use commercially practicable, is entirely due to the development of burners in which by the induction of so-called turbulence the long flames previously associated with pulverised fuel combustion have been considerably shortened.

The above considerations illustrate the fact that when heat only, as distinct from power, is required, provided that the application is one where comparatively low temperatures are aimed at, as for instance in the production of steam, probably the most efficient method of utilising coal is in its raw state. But there are many industrial operations such as metal working and various chemical processes, which demand far higher temperatures. Furnaces designed for these purposes necessarily have much poorer efficiencies than steam boilers, since the combustion gases are inoperative for the purpose in hand as soon as their temperature has been reduced to the temperature at which the operations are being carried out. The higher the furnace temperature the greater the relative heat loss by sensible heat in the flue gases, and therefore the poorer the efficiency. In such cases, of course, the working efficiencies may usually be considerably improved by recourse to recuperation or regeneration; or, when there is a ready demand for the steam produced, by waste heat boilers. A further loss may occur through incomplete combustion of the furnace gases, and may be partially unavoidable on account of the necessity for a reducing atmosphere inside the furnace chamber.

In all furnaces operating at high temperatures effective control of combustion conditions and efficient recovery of flue gas heat therefore play a vital part in the attainment of good results, and on this account gaseous or liquid fuels offer many advantages over raw coal. Electric furnaces, not being dependent on hot combustion gases for their operation, are no less efficient at high than low temperatures except through increased "radiation" losses. In such cases the higher working efficiencies and greater convenience may more than compensate for the extra initial cost of the potential heat units, although if the electricity is generated from coal the maximum overall thermal efficiency coal-heat power-electricity-heat yet possible is only about 20%, mainly on account of the low efficiency of conversion in the step heat to mechanical power.

Where, however, mechanical power is required as such, there is little difference between the overall thermal efficiencies of the various methods of supply, since at one stage or another the low efficiency transformation of heat into power is inevitable. For instance, although electricity is produced from coal at only about 20% efficiency, the subsequent conversion of electricity to mechanical power can in large units be effected with little further loss; whereas although heat can be produced from coal at very high efficiency, the subsequent conversion of heat to mechanical power is a low efficiency one, say 25 to 30%.

The domestic field offers a somewhat difficult problem in efficient fuel utilisation since, generally speaking, a diversity of heat requirements, small individually, but substantial in the aggregate, have to be provided for separately in every household. Raw coal is still the fuel mainly used, although its substitution by gas, coke and electricity is gradually taking place. The annual consumption in this country is about 40 million tons, or over 20% of the total

quantity mined. This on the whole is burned very extravagantly and produces relatively large quantities of tarry smoke. The unsatisfactory results obtained are to be attributed in part to the facts that a single fire is usually relied upon to perform several separate services, that small appliances are inherently inefficient, that with solid fuel it is usually necessary to maintain continuously the fires of plant needed only intermittently, and that the average housewife is totally ignorant of the principles of combustion and heat transfer.

As a rule, gas and electricity appliances are far more efficient than their solid fuel counterparts, but the advantage is not always sufficient to overcome the higher initial cost of the heat units. Gas, however, is becoming general for cooking and intermittent heating purposes, for both of which it can usually compete favourably with raw coal in point of cost. But the extent to which raw coal still holds the domestic field is evidenced by the persistence of so enormous a demand for it. The rational solution of the problem appears to be the provision of a smokeless fuel at a competitive price. It is partly for this reason that so lively and widespread an interest has been shown in the possibilities of the production, by low temperature carbonisation or other methods, of improved forms of coke.

NOTES ON BOOKS

ART IN SCHOOLS. By J. Littlejohns. University of London Press. 10s. 6d.

Both the body of this book and the introduction, by Mr. R. R. Tomlinson, show unusual humour and humanity. It is a happy fact that the "little boys should be seen but not heard" attitude in education is rapidly diminishing; not in "cranky" schools only, but also in schools under the Government little boys are being invited to express themselves. The debt we owe to modern psychology is immense, for this new science helps us to prevent as well as to heal damage to the spirit and the character. The prophylactic measures advocated consist largely in encouragement for the young to express themselves through the medium of some art or craft.

Already in their first two or three years, in what Mr. Tomlinson calls "the stage of Manipulation," children gain by being allowed to use a pencil. We are not surprised to find that the next two stages, those of Symbolism and Realism, come in the same order as the corresponding stages in the history of art; as naturally they are followed by the stage of "Awakening," when the children wish to express their own personality with greater emphasis.

In the past, teachers neither knew these broad facts nor were in a position to learn them and act upon the experience acquired. But progress has been made, and by an interesting circuitous route even taste is a little coming into its own. It is recognised that a teacher without sensibility will be unable, first, to establish the necessary contact with children whose individual propensities it is intended to foster, and, secondly, direct their attention to suitable models.

This book, which is to be highly recommended, contains a number of excellent hints for teachers on how to stimulate the powers of observation; these hints suggest types of expedients which can always be varied according to the circumstances and location of a school.

P.B.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4004.

VOL. LXXVII.

FRIDAY, AUGUST 16th, 1929.

*All communications for the Society should be addressed to the Secretary, John Street,
Adelphi, W.C.(2.)*

NOTICE.

THE QUEEN AT THE SOCIETY'S EXHIBITION OF DESIGNS.

H.M. the Queen, accompanied by the Hon. Margaret Bigge and the Hon. Gerald Chichester, paid a visit on Friday, August 9th, to the Royal Society of Arts Exhibition of Industrial Designs which is being held during this month in the Exhibition Pavilion of the Imperial Institute, South Kensington. Her Majesty was received by Mr. Llewelyn B. Atkinson, M.I.E.E., Chairman of the Council of the Royal Society of Arts, Lieut.-Gen. Sir William Furse, K.C.B., D.S.O., Director of the Imperial Institute, and Mr. W. Perry, the Assistant Secretary of the Society.

Her Majesty inspected all the work shown, expressed much interest in the Exhibition and was graciously pleased to purchase one or two pieces of pottery.

The Exhibition will be open free of charge, no tickets being required, until September 1st, every week-day from 10 a.m. to 5 p.m. and on Sundays from 2.30 to 6 p.m.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE TREATMENT OF COAL.

By C. H. LANDER, C.B.E., M.Inst.C.E., M.I.Mech.E., F.Inst.P.,
Director of Fuel Research, Department of Scientific and Industrial Research.

LECTURE II.

(Delivered January 28th, 1929.)

In the first lecture, after touching on some of the newer methods of investigating the constitution of coal seams, it was pointed out that in dealing with the scientific aspects of burning coal in the raw state, the simpler forms of

physical and chemical investigation give adequate information. Where processes of carbonisation or hydrogenation of coal have to be considered, however, a more exhaustive and intimate knowledge of the coal substance is desirable. The subject has been studied for many years in some detail, but it is only comparatively recently that the work of different experimenters has tended to converge and produce results of tangible importance. It would be impossible in a series of lectures such as these to deal adequately with the immense mass of work which has been carried out. Sufficient for the present purpose will be to mention one or two of the more recent outstanding researches.

In a long series of investigations on the extraction of coal by various organic solvents, Bone¹³ has interpreted his researches as showing that a group of nitrogenous "humic" bodies, varying in quantity according to the nature of the coal, can be extracted by benzene under pressure, and he considers that these bodies are mainly responsible for the coking propensities of coking coal. He points out that the residues left after the completion of the extraction are non-caking, and he believes the bodies extracted by benzene to be pre-existent in the original coal complex and not derived from it by chemical decomposition.

Cockram and Wheeler¹⁴ have extracted coal with a series of solvents and in this way have separated a number of fractions, to each of which they attribute definite properties. They conclude from their research "that the agglutinating medium during coke formation consists of the resins and hydrocarbons contained in the coal or is yielded by those resins and hydrocarbons during the early stages of heating in the coke oven."

Francis and Wheeler¹⁴ have also developed a new method of studying coal composition which they term "Rational Analysis," and which forms a valuable addition to the usual methods of analysis. A rational analysis of a coal can be given in terms of the proportions of free hydrocarbons and resinous compounds, organised plant entities, and ulmin compounds, together with the reactivity towards oxygen of the ulmin compounds. In rational analysis, the hydrocarbons and resins are grouped together. "These are oil-yielding constituents of high hydrogen content and their presence in the coal in suitable amount affects (but is not wholly responsible for) its coking power." "The spore exines and cuticular tissues, which form the bulk of the morphologically organised plant entities, are of high hydrogen content and are oil-yielding constituents of the coal, the oils consisting mainly of paraffins and unsaturated

¹³ Bone, W. A. Researches on the Chemistry of Coal, Part III. The Extraction of Coals by Benzene under Pressure. *Proc. Roy. Soc. A.*, 1924, 105, 608.

¹⁴ Cockram, C. and Wheeler, R. V. Studies in the Composition of Coal. The Resolution of Coal by means of Solvents. *J. Chem. Soc. Lond.*, 1927, IV.

¹⁴ Francis, W., and Wheeler, R. V. The Rational Analysis of Coal. *J. Chem. Soc. Lond.*, 1928, 2967-2979. "

hydrocarbons." The ulmins form the major portion of the coal and they vary in composition with the rank of the coal.

Bone and Quarendon¹⁵ found that when the residue resulting from the extraction of coal with benzene under pressure was oxidised by treating it with alkaline potassium permanganate, 20-40% was recovered in the form of acid oxidation products, from which mellitic acid and benzene—1 : 2 : 3 : 4—tetra-carboxylic acid was obtained. From this they conclude "that coal actually contains 6-ring structure." The continuation of this work has been assisted by a grant from the Department of Scientific and Industrial Research.

Some confusion exists regarding the interpretation of the term "decomposition point" of coal. It is clearly necessary to distinguish between products distilled from the coal without change and those resulting from the decomposition, however slight, of organic matter. King and Willgress¹⁶ have carried out experiments to ascertain the initial temperature of carbonisation of coal. They have shown that if coal is carefully heated out of contact with free oxygen decomposition takes place with the liberation of visible amounts of liquid oils at temperatures varying from 180°C. for peat, to 215°—245°C. for bituminous coals. With bituminous coals the temperature of initial decomposition appears to increase with increasing oxygen content and decreasing carbon content.

Holroyd and Wheeler¹⁷ have published a paper in which a method for determining the decomposition point of coal is described. "The method of experiment involved the heating of 250 gram charges of finely powdered coals under a high vacuum at different temperatures. Under these conditions the action of heat on the individual ingredients of the coal could be followed comparatively easily. No marked decomposition occurred with any bituminous coal below about 300°C." A considerable number of coals were studied by this method and it was found that the decomposition point ranges from 290-300°C. to 360-365°C. Holroyd and Wheeler state, "We are satisfied that the temperature at which oils first make their appearance when a bituminous coal is heated is not the temperature of initial decomposition of the coal, but that such oils are distilled unchanged. In our experience, the temperature at which such oils first appear bears no relation to the carbon content of the coal. It has, however, a tendency to be lower the greater the proportion of free hydrocarbons in the coal." In view of such conclusions it would appear that some more accurate agreement upon the use of the term "decomposition" as applied to the coal aggregate is necessary.

¹⁵ Bone, W. A., and Quarendon, R. Research on the Chemistry of Coal. Part IV. The Oxidation of the Residue from the Benzene-Pressure-Extraction Process. *Proc. Roy. Soc. A.*, 1926, 110, 537-42.

¹⁶ "The Primary Decomposition of Coal." *Fuel Research Board Technical Paper*, No. 16. H.M. Stationery Office, 1927.

¹⁷ Holroyd, R., and Wheeler, R. V. Studies on the Composition of Coal, Oil Yielding Constituents. *J. Chem. Soc. Lond.*, 1928, p. 2669.

A question of more immediate practical value than the above-mentioned considerations is a method for determining the coking characteristics of different coals. Several types of assay provide the requisite information about the type of coke produced from a given coal and indicate also the comparative yields of tar, gas and liquor. By means of correlation with a considerable number of results from experiments carried out on a large scale in different carbonisation plants it has been shown that assay results can be successfully interpreted in terms of large scale working. Further, the method can not only be used for the characterisation of coal but also for the determination of the most suitable blends of two or more coals for coking purposes.

In dealing with high temperature carbonisation it must be remembered that this process forms the basis of two very large industries at the present time together consuming nearly 40 million tons of coal, namely the gas industry and the coking industry. The technique of these industries is based upon experience extending over something like 100 years. Although suffering from present industrial conditions, both industries have been profitable in the past, are in many parts of the world profitable at present, and will most probably become profitable again in the future. In industries such as these technical advances are not likely to follow some revolutionary change or discovery, but rather to result from the painstaking labours of the men in charge in applying up-to-date knowledge to their own local conditions, so as to produce minor improvements, perhaps individually of the order only of 1 or 2 per cent., but which in the aggregate may reach enormous figures.

In this connection it is of interest to mention one economy which has arisen partly from the work at the Fuel Research Station. In a setting of vertical retorts the whole face was studded with cast iron sight boxes through which what was going on in the combustion chambers could be seen. As a result of some repairs being necessary to the retorts the opportunity was taken of replacing the sight boxes by fireclay plugs. The retorts, of course, had been used and were always used for experimental work. There was accurate knowledge of the amount of heat that was used in the setting, including the amount credited to radiation. After the change, the amount of heat required was reduced by one-sixth, equivalent to a thousand cubic feet of water gas per hour. It is not claimed that this result was solely responsible for what followed, but it certainly bore its part. It is now recognised that the putting in of such boxes resulted in an enormous waste of heat, and the makers of those retorts are now putting in fireclay plugs; in their house journal they said it was the result of the investigations at the Fuel Research Station. The total saving of fuel to the country, multiplied by four-fifths, the amount automatically passed on to the consumer under the Gas Regulation Act, comes to about £45,000 to £50,000 per annum, which is the total cost of the Research Station at East Greenwich.

The aims of the two established high temperature carbonisation industries are distinct. The function of the gas industry is to provide, through centralised sources, gas at the lowest possible cost to the consumer. The function of the coking industry is to produce coke of a type which shall fulfil the requirements of the user, mainly at present the iron and steel manufacturer, so that his overall operations may be profitable. To be able to buy coke as such at the lowest possible price is not necessarily the primary consideration; the chief desideratum is rather that the character of the coke procured shall be such as to enable the subsequent operations of iron and steel making to be carried out with the greatest overall commercial efficiency.

Dealing first with some of the points of high temperature carbonisation as affecting the gas industry, it is not always recognised by the critics of this industry that the cost of gas into the gasholder is only a fraction of the average cost to the consumer, and indeed that the cheapest gas into the holder is not necessarily the cheapest to the consumer. A gas company is both a wholesaler and a retailer. Its customers consist of practically every household in the area which it supplies, most of these households taking gas in very small quantities, and on this account distribution and management charges must be high. As a result, the price of gas to the consumer is usually about three times the cost into the holder, and it is obvious that the reduction of charges other than those directly associated with actual manufacture may in many cases have an effect on the supply of cheap gas as great as or greater than any to be accomplished through improvement in manufacture. In other words, the cost to the consumer includes, besides the cost of manufacture, the following items:—(1) distribution (2) maintenance of fittings, and (3) management. It is obviously of great importance to adjust the processes of manufacture not merely in such a way as to obtain the lowest price in the retort house, but also bearing in mind the possibility of savings in distribution or other costs.

The main factors of manufacture which have an effect on the distribution costs are as follows:—(a) Specific gravity, since this affects the cost of pumping and the total amount of heat that can be got through the mains. (b) Calorific value, since the volume of gas which must be delivered to the consumer is roughly inversely proportional to the calorific value. (c) Water content, since this also affects deleteriously the cost of distribution. (d) Naphthalene, which tends to deposit and choke the pipes, and which, if allowed to accumulate, entails increased pumping costs. (e) Carbon di-sulphide, which causes rapid deterioration of fittings. These are only some of the points which have to be taken into account by every gas manager in determining the degree of elaboration which he must face in order that the cost of gas to the consumer may be a minimum.

It is sound policy to introduce more expensive processes for effecting reduction of specific gravity, increase of calorific value, removal of water, freedom from

naphthalene deposits, reduction of organic sulphur compounds, etc., if their additional cost can be more than counterbalanced by consequent reductions in distribution, maintenance or management expenses.

During the past 25 years a quiet revolution has taken place in the gas industry. The greater use of gas for heating purposes, coupled with the replacement of the old bat's-wing burner by the incandescent mantle, has gradually rendered the old illuminating standards obsolete, and at the present time the only requirement of the consumer is heat. The trend of the industry during this period is so well-known as to render any detailed discussion superfluous. It will be remembered, however, that the whole question of illuminating standards and calorific value was brought to a focus in 1919 when the Board of Trade asked the late Sir George Beilby, then Chairman of the Fuel Research Board, and Director of Fuel Research, to examine the question generally and advise as to any changes which ought to be made in the legislation governing the matter.

Much experimental work was carried out at that time both by the industry and by the Fuel Research Board on the bearing of calorific value *per se* upon the consumers' requirements, and it was shown that within certain wide limits the consumer could be as well served by a gas of low calorific value as by one of high calorific value, provided the consuming appliance was designed in such a manner that it could supply, by an increase in the volume, sufficient gas to give the total heat requirements for the particular purpose in view. This result, whilst including such operations as the boiling of water which do not require high temperatures, was somewhat less easy to demonstrate where flame temperature is of importance, as in the heating up of an incandescent mantle. The question of flame temperature, however, and its bearing on incandescent illumination was studied at Leeds by the Gas Investigation Committee of the Institution of Gas Engineers.¹⁸ When gas is burned the theoretical flame temperature depends upon the ratio between the heat developed and the heat capacity of the so-called flue gas, and it was shown that over a wide range of gas mixtures this ratio remains substantially the same and that the theoretical flame temperature attainable is therefore much the same throughout. In other words, equal amounts of light will be got in an incandescent burner from two gases of widely different calorific value, provided the appliance is such that the necessary number of B.Th.U. can be delivered. Actual experiment revealed differences, but these could be accounted for by such factors as size and shape of flame, etc.

It was pointed out by the Fuel Research Board that the fixing of a uniform low standard of calorific value might be as great a danger in the development of the industry as the fixing of a uniform high standard would be, and that the desired elasticity could best be obtained by so safeguarding the interests of the consumer that each gas undertaking might be given freedom of choice

¹⁸ Second and Third Reports of the Gas Investigation Committee of the Institution of Gas Engineers, 1919, 1920.

as regards raw materials, processes of manufacture and quality of gas, so that it might be in a position to meet the needs of the locality most satisfactorily. It was therefore recommended that the consumer should be charged for the thermal units which he actually received in the same way in which the consumer of electricity was charged for the Board of Trade units recorded by his meter,¹⁹ and this recommendation was subsequently incorporated in the Gas Regulation Act (1920), which decreed that gas should be sold by the therm (100,000 B.Th.U.). Under this Act there is a self-declared standard of calorific value to which each gas undertaking must adhere, but which can be changed after due notice. The important duty of adjusting the consumers' fittings to the new calorific value, however, devolves upon the gas companies.

Since the Act of 1920 there has been a general reduction in the price of gas. This is due in part to the gradual reduction in the costs of labour, materials, etc., which has taken place since the war; but it is fair to claim that a considerable proportion of the reduction is to be attributed to the freedom which has been given by the Act to the gas manager to adapt his operations to his own local conditions, taking into account all the factors which affect cost, both in the retort house and in the distribution system.

Another great change in gas industry practice has also occurred during the past 25 years, namely, the introduction and development of the modern vertical retort, which is now so widely used that roughly 50% of the coal carbonised by the industry is effected in this type of appliance.

The history of vertical retorts is another illustration of the point made at the beginning of this lecture, namely that in an established industry such as gas manufacture, progress depends essentially upon refinements capable individually of effecting only small improvements. That this is so is borne out by the fact that vertical retorts have not completely replaced horizontals. The points of advantage which vertical retorts can fairly claim are the following. More gas is made per square foot of ground space than can be produced from horizontals. Under the confined conditions which must necessarily exist in a large town this point is obviously of the very greatest importance and tends to become more and more so as time goes on. When vertical retorts were first introduced they occupied for the same gas make about one-seventh of the ground space of horizontal retorts; but with more recent developments in horizontal retorts, such, for instance, as the gradual increase in the practice of high benches, the vertical retort has lost some of this advantage, and now occupies about one-third of the ground space of the horizontal. This is an example of the way in which new appliances put older types on their mettle and tend to the improvement of the whole practice. Another advantage of the vertical retort is that in general the labour cost per therm of gas made is less. The capital cost per therm may also be lower, and again a lower fuel consumption

¹⁹ "The Therm," *Department of Scientific and Industrial Research*. H.M. Stationery Office, 1922.

per therm gives a higher carbon efficiency. The gradual development of waste heat boilers during the past few years has again increased this important ratio. Another point in favour of the vertical retort is that it is easier to produce dry coke without complicated auxiliary appliances.

Such a recital of the merits of verticals necessarily begs the question as to why the horizontal retort still survives at all, but it should be pointed out that vertical retorts work best with nut coal, although they will give satisfaction with any size except fine slacks. On the other hand, they are more susceptible to variations in the type and quality of the coal, and on this account require a higher grade of intelligent control. In gas works of any appreciable size, however, it is usually recognised that the best possible supervision is essential in any case, and therefore this requirement of verticals cannot properly be accounted a disability. The chief advantage of horizontal retorts is that they will take any coking coal of any size and give satisfaction, and a change in the character of the coal within fairly wide limits does not affect their working. To get the best results in any method of carbonisation, blending is of great importance, but it must be carried out in the light of extensive knowledge of the properties of the coals dealt with. Mere partially-controlled blending of the two types of coal will not give the fullest advantage. In general, blending is of more advantage in horizontal retorts than in vertical retorts.

The relative advantages of low and high grade gas have in the past been the subject of bitter controversy. It is possible that low grade gas could be produced by complete gasification at a lower cost per therm, but its true position in relation to high grade gas must in every case be based also upon close analysis of its effects upon distribution and storage charges. Low calorific value gas involves the delivery of increased volumes, and since its specific gravity is also higher these two factors combine to make it more expensive to distribute, owing to their influence upon such factors as the size and cost of mains, distribution pressures, size and cost of meters and service appliances, etc.

The above considerations do not by any means exhaust all the points which have to be taken into account in the running of the gas industry. There is one point, however, which is perhaps not always appreciated as well as it should be, namely, the question of benzol scrubbing.

At the conclusion of the War the gas industry very rapidly dropped the extraction of benzol, the line of argument being that with gas at 10d. a therm the value of the heat content of the benzol, if allowed to remain in the gas, was the equivalent of 1s. 3d. a gallon. Before this benzol could be sold it had to bear the cost of extraction, and before it could be supplied to the internal combustion engine it had to bear the cost of distribution. Suppose, for the sake of argument, the cost of extraction is taken as 7d. a gallon and the cost of distribution to filling stations or in cans as 6d. a gallon; then the cost of gas works benzol, without including any profit, into the consumers' motor

car, would amount to 2s. 4d. per gallon. At first sight this appears to be a very potent reason why it may be more profitable for the gas industry to sell benzol as town's gas rather than in the liquid form ; but, although admittedly it would in any case be difficult to compete with petrol at its present price, it is doubtful whether such arguments are altogether sound. It must be remembered that since the gas supply has to be maintained benzol extraction would entail an increase in the amount of coal which has to be carbonised, and taking everything into consideration the cost of liquid benzol to the gas company might be considerably less than the figure assigned to it on the above assumptions. Further, gas works benzol is now protected to the extent of 4d. a gallon, and any increased extraction of benzol in gasworks for subsequent utilisation as motor spirit tends to national advantage by avoiding the importation of so much petrol. The difference may be very small, but it is all to the good.

The question of heating retorts is worthy of consideration in some detail. The built-in producer is at present the accepted method, but by adopting in suitable cases a centralised supply of clean producer gas the saving in retort repairs, the better control secured, etc., might more than pay for the loss of heat involved in not delivering hot gas direct from the producers. For experimental purposes the Fuel Research Station has always worked with a central supply of fuel gas delivered under pressure to the retorts. Accurate knowledge as to what effect the introduction of this practice would have in gas works is not claimed, but it is extremely likely that it would tend to better control of the heat. If the producer gas were clean and ash free this would be reflected in the cost of upkeep and deposits in combustion chamber. Again, by carrying a slight pressure in the combustion space, outleakage of coal gas would be obviated, and, instead, a slight leakage would take place inwards to the carbonising chamber. The disadvantage of inleaking is dilution in the "make" gas, but the disadvantage of leakage outwards is the consequent tendency of gases to ignite round the leaky places and cause rapid deterioration and failure of the retorts round these spots. A most striking illustration of this has recently been afforded at the Fuel Research Station, where after two years' working under pressure, the combustion chambers of the horizontal retorts were in a condition almost indistinguishable from new. (Fig. 5). Whilst cooled down the plant was inspected by a number of experts, including coke oven managers, who were all impressed with the success of this method of operation, which is largely due to the abilities of the Works Superintendent, Mr. G. Percival. It is understood that the method is being tried in one large gas works.

The question of heating the retorts by a proportion of their own coal gas during off-peak periods merits some attention. This has frequently been done at the Fuel Research Station when experimental work is not being carried out. With coal gas in its pure state difficulties may arise due to the formation of

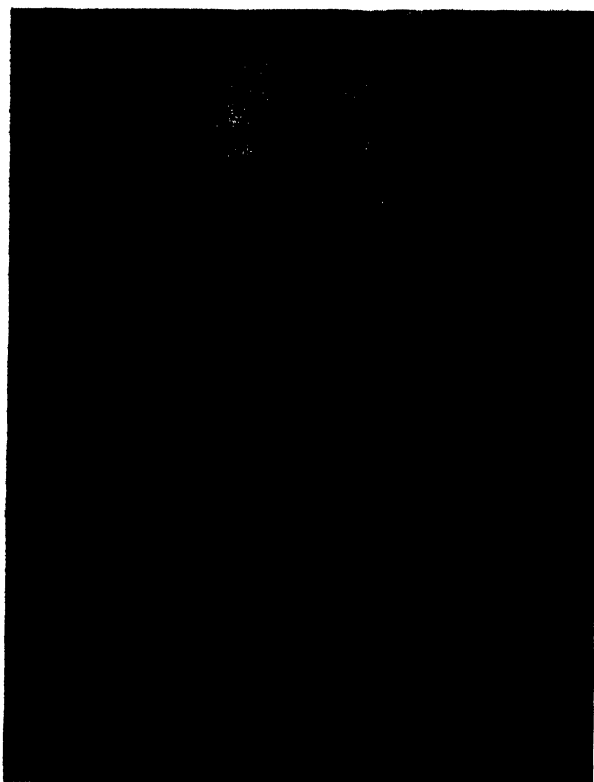


FIG. 5.

Combustion Chamber of Horizontal Gas Retorts at Fuel Research Station after working under slight positive pressure at 1350°C. for two years.

lamp-black, and careful supervision is required; but if the coal gas is subjected to a mild cracking process before being utilised, so that it is transformed into a rich producer gas, no difficulty at all is experienced with as much as 50% coal gas and 50% fuel gas made from coke, provided that proper precautions are taken. Similar experiments are being carried out by the industry and by the use of modified burning appliances it may become possible to utilise 100 per cent. coal gas.

Turning now to the question of coke, there is an undoubted demand at the present time for improved qualities. It is possible to produce gas coke which possesses many of the advantages claimed by newer types of low temperature fuels; but if present day developments continue, the market for gas coke may be seriously affected by the competition of cokes from other

processes, including that from coke ovens. In order to develop the fullest advantages of gas coke it is essential that it shall be (a) dry (b) clean and (c) screened. Dry coke can be obtained by greater attention to quenching. Clean coke can be made only from clean coal. At the present time the gas industry has to pay something like 2/- per ton more for cleaned than for uncleaned coal. This comparatively large increase in price is due to several factors, and introduces the question as to whether the gas industry should install their own cleaning plant. Gas companies, however, usually have to draw their supplies of coal from many sources, whereas cleaning plants are not appliances of the greatest flexibility, and in order to give the best efficiency must be adjusted to the type of coal dealt with. The correct place for cleaning plant is at the coal mines; in this situation, when once adjusted to the optimum results from the collieries' coal, it would continue to work under the best conditions with very little trouble and adjustment. Again, the market for cleaned coal is not a large one, and even where cleaned coal is available it is likely to account for only a small proportion of the collieries' output. If, however, there were a greater demand from gas works for cleaned coal the cleaning operations of the collieries would be stimulated, and the price of the treatment should tend to fall.

This question of cleanness of the raw material cannot be stressed too strongly if a fuel is to be made for household purposes, whether by coke ovens, gas works or low temperature carbonisation plants, situated either at a colliery or at a gas works. Experience with low temperature coke has shown the amount of ash left in the grate to be a common cause of complaint from householders. It is a curious fact, although one capable of explanation, that 7 per cent. of ash in a coal burned in the raw state in a household appliance is much less obvious and less of a nuisance than 7 per cent. of ash in a coke of any kind.

Some of the considerations given above are equally applicable to coke oven practice, but it must be emphasised that, at any rate at the present time, the major output of the coke ovens is for blast furnace purposes. The blast furnace manager recognises the fact that he must have coke of a certain type and quality and he is willing to pay for such a coke.

Blending has been made some use of in the coke oven works of this country for many years, but it is now becoming an essential control factor in Continental practice. Some of the enormous installations on the Continent incorporate the most elaborate coal blending arrangements, which are supervised with the highest skill. During the last year or so attention has been paid on the Continent to the possibilities of blending with low temperature coke. For instance one works on the Saar, using a particularly fat form of coal, have had in the past to import a more feebly caking coal from a considerable distance. They have now experimented in the direction of using some of their very fat coal in a low temperature plant, and employing the residue so obtained as a blending material in the main coking works. The advantages

claimed are a considerable reduction in the carbonising time, and the production of a coke better suited to the purpose for which it is needed.

Such experience indicates the necessity of installing an experimental large scale coke oven plant in this country so that the effects of changes in working can be accurately studied. The present method of relying upon bag tests is uncertain and frequently gives misleading results. The tendency of industry in this country to look at the aggregate cost of the research work which it undertakes, and lose sight of its cost relative to the large interests involved, is to be deplored. The appointment by the Board of Trade on the recommendation of the National Fuel and Power Committee²⁰ of a Committee to consider the possibilities of closer co-operation between gasworks and coke ovens in a certain defined area is a step which will clear up many uncertainties and controversies in the particular fields concerned.

The type of work which has been described in this Lecture consists in obtaining improvements which result in the aggregation of a number of small economies, rather than in anything phenomenal, or anything which would provoke big headlines in the newspapers. Such work is often of a kind difficult to carry out satisfactorily by research associations, or in any industrial concern where large scale apparatus must defer to the interests and demands of consumers. The Fuel Research Station, on the other hand, is specially equipped for it. At the Station there is close contact with certain firms interested in fuel utilisation, as well as with technical people who are familiar with the various branches of the subject; but it would probably be an advantage both to us and to them if some closer measure of co-operation could be assured.

²⁰ Report of National Fuel and Power Committee (1928), p. 30.

WATER POWER IN SWITZERLAND.

In January, 1927, the rating of hydro-electric plant installed or in course of erection in Switzerland was given as 2,220,000 h.p., made up of 1,859,000 h.p. installed at the end of 1925, 41,000 h.p. put into service in 1926, and 320,000 h.p. building. In 1925 140,000 h.p. were installed. According to a report by His Majesty's Minister at Berne, the present development represents about one-fourth of the total power resources of the country.

The power output of Swiss electric works in 1926 is placed at about 4,000 million kwh., or roughly, 80 per cent. of the maximum available output. Power and light absorbed 2,250 million kwh., about 775 millions were exported, and a similar amount was consumed in the electro-chemical and metallurgical industry, whilst 200 millions were used for traction. Atmospheric conditions were fairly favourable for power production. A large station working on accumulation and completed in 1925, afforded valuable assistance in tiding over a period of drought at the end of the winter 1925-26. Exports of power are being looked upon as an increasingly valuable source of national revenue, and the steps taken by the Federal authorities in 1924 to bring about a more healthy state in export conditions are now bearing fruit. Considerable care is exercised by these authorities in issuing export licences. Contracts on an exchange basis were concluded in 1926 by some power companies for the export of surplus summer output and the import in winter of power produced by thermic stations abroad.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4005.

VOL. LXXVII.

FRIDAY, AUGUST 23rd, 1929.

*All communications for the Society should be addressed to the Secretary, John Street,
Adelphi, W.C (2.)*

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE TREATMENT OF COAL.

By C. H. LANDER, C.B.E., M.Inst.C.E., M.I.Mech.E., F.Inst.P.,
Director of Fuel Research, Department of Scientific and Industrial Research.

LECTURE III.

(Delivered February 4th, 1929.)

The third and final lecture of this series is to be devoted particularly to a consideration of low temperature carbonisation and also of those chemical processes which have for their object the conversion of a much greater proportion of the coal substance into liquid fuels than can be effected by any method of carbonisation.

In view of the large amount of discussion, both at conferences and in the press, which has taken place on low temperature carbonisation during the last two years, it seems unnecessary at this stage to describe at length what low temperature carbonisation is, or to go closely into the benefits which it is claimed would result from a wide application of the system. Low temperature carbonisation has been put forward from time to time by interested parties as a panacea for various ills in such exaggerated terms as have tended to discredit it. On the other hand, largely owing to the painstaking efforts of certain groups of investigators, working in harmony with each other, there has undoubtedly been a great access of knowledge; and although there does not lie behind low temperature methods the wealth of practical experience and information which backs up the successful commercial operations of the established high temperature carbonisation industries, the technical problems

involved have now been largely overcome, and at the present time there is taking place in various quarters a steady development of types of apparatus based on sound principles. The time is definitely past in which the enthusiasm of over-sanguine promoters dare venture to make such claims as that low temperature carbonisation should be substituted entirely for high temperature gas works operations, or be applied generally as a preliminary process to all our coal. Much confusion has resulted from a lack of proper appreciation of the bearing of local conditions upon the commercial success or failure of low temperature methods. From time to time plants are reputed to be in commercial operation abroad, and in certain cases, although not so many as are sometimes supposed, with a foundation of fact; but here again the question is affected by the different requirements of the different countries. For instance, in America the problem presented is essentially dissimilar from our home problem. In the United States the primary requirement is not a coal substitute for use in the open grate, but a product which can be made from a cheap raw material and sold as a competitor of high-priced anthracites. Further, the liquid products in a country so rich in natural petroleum have not by any means the same significance as in the British Isles. It is obvious that when there is a large margin between the price of the raw material and the price which can be obtained from its resultant product, the chances of commercial success are greatly enhanced. In this country the claims made for low temperature carbonisation, which in the main are quite justifiable, are twofold. Firstly, it would provide a source of fuel for the domestic grate and so would tend to make the country much cleaner, since a large proportion of our smoke nuisance is derived from the burning of coal in these appliances. Secondly, since our geological formations are not able to provide directly any appreciable quantities of natural liquid fuel, we are forced to import from overseas a material which during the last twenty years has rendered itself vital to the continuance of the social conditions of the country in their present form. The quantities of oil and light motor spirits which are now used have become so great as to render it extremely unlikely that the complete replacement of sea-borne oil by a home by-product obtained from a carbonisation process could ever take place, but it is almost platitudinous to say that anything that could be done towards this end would be of great national advantage.

The question of national defence has often been emphasised in this connection, since very large quantities of liquid fuels of various kinds are essential in times of national emergency. Considerable stress was perhaps legitimately laid on this point some years ago, but the great growth in the estimated requirements for national defence now render it absolutely impossible to satisfy them except to a very small degree by a mere by-product. If, on the other hand, a really large proportion of the coal substance could be directly converted into oil, the position would be very different, and when discussing developments in the hydrogenation of coal, or the synthetic production of

motor spirit from water-gas, these arguments very properly come into the picture.

Although it is not feasible to discuss in detail the numerous designs of low temperature carbonisation plants which have been proposed, certain of the more outstanding types which have been tested by the lecturer in his official capacity will be briefly described at a later stage. It is of interest to note that all these can be separated broadly into two main groups, according to the method of application of heat. In one group are found a large number of systems in which the coal is treated in a gas-tight container, the heat being applied from the outside and having to traverse the walls of the container. Such processes may be either intermittent or continuous, but in general an intermittent or semi-intermittent system presents advantages in this type of plant. The second group comprises those plants in which the heat is applied internally by the introduction into the coal container of a heating medium, which is usually either some form of producer gas or super-heated steam, or a mixture of the two. Both of these methods have their advantages and disadvantages, and they are not really competitive. When a dense smokeless fuel in lump form for household purposes is required the externally-heated type of retort has certain obvious advantages. If, however, for the particular purpose in view the fuel is not necessarily required in the lump form, or if there should be some property inherent in the coal to be treated which renders it possible to produce a satisfactory proportion of lump fuel even by internal heating, this latter method makes for economy, since the time necessary for carbonisation is shortened.

The Fuel Research Board put the question of low temperature carbonisation in the forefront of the programme which they drew up some twelve years ago,²¹ and they have worked steadily on with it ever since. Various methods were tried in the earlier stages of the investigation, but it was soon decided to pursue the work mainly along the lines of externally-heated retorts. As a preliminary the Board examined the results already obtained by various experimenters, but with one or two exceptions such results proved to be extremely nebulous, and, in addition, the whole subject was found to suffer from a certain lack of concentration. Inventors had tried to do too much at once; having obtained, for instance, a partial success on one type of coal they were immediately anxious to prove that their system could be extended to many other types; and so wasted time, money and energy in the exceedingly superficial survey of too wide a field. In certain cases, on encountering some difficulty in connection with details in plant design, there had been too great a hurry to change such details before the scientific factors governing the disability were fully understood. Few people stuck to a well defined path and resisted the temptation to explore by-paths until they had really found

²¹ Report of the Fuel Research Board on their Scheme of Research and on the Establishment of a Fuel Research Station. (H.M. Stationery Office, 1917).

what their main work was leading up to. Serious failures occurred through the erection of large batteries consisting of a multiplication of units long before the unit itself had been properly tried out. In the early days very large amounts of money were squandered, and the whole subject offers a striking example of what has been aptly termed "research by catastrophe."

When the Fuel Research Board commenced its operations there were, however, several types of externally-heated plant which were the subject of careful and conservative development. One or two internally-heated types of retort were also under investigation in very able hands. The Scottish Shale Oil Industry had for many years successfully employed low temperature processes for the distillation of shale, and many useful data were available from this source. It must not be forgotten that this industry itself was originally started to develop James Young's patents for making lamp oil and paraffin wax from bituminous coal. The early operations of the gas industry also incorporated what were really low temperature methods, since carbonisation was carried out in cast-iron retorts which could not withstand temperatures much in excess of 600°C to 700°C . The methods adopted, however, in these old industries required radical modification and development before it could be hoped to make a commercial success of the treatment at low temperatures of bituminous coal under modern conditions, an important factor in which is the competition of naturally occurring oil.

Up to the present it has not been definitely proved by anyone that commercial success has been obtained, and indeed the time has been too short for such definite proofs to be forthcoming. Many of the earlier plant by their inability to survive have demonstrated the difficulty of making a real profit, but so far no installation of reasonable size has reached the stage of being able to put forward a satisfactory audited profit and loss account. In this connection it is important to remember that the technical working of a plant is by no means the only factor controlling its commercial prospects, but that these are also affected to a considerable degree by local conditions. Further, successful commercial working is probably more dependent upon competent management than upon any other single factor.

Although the economic position of low temperature carbonisation must still be looked upon as somewhat uncertain, there is little doubt that the process is now definitely launched. Several large scale plants are already running, others are in process of erection, and reliable commercial data should shortly be available. The different systems will stand or fall according as they can or cannot pay dividends from the results achieved in ordinary day-to-day working.

The primary object of the work originally undertaken by the Fuel Research Board was to obtain systematic and accurate technical data relating to low temperature methods. It was obviously an impossible undertaking for any single organisation, however well equipped, to try out all of the many methods

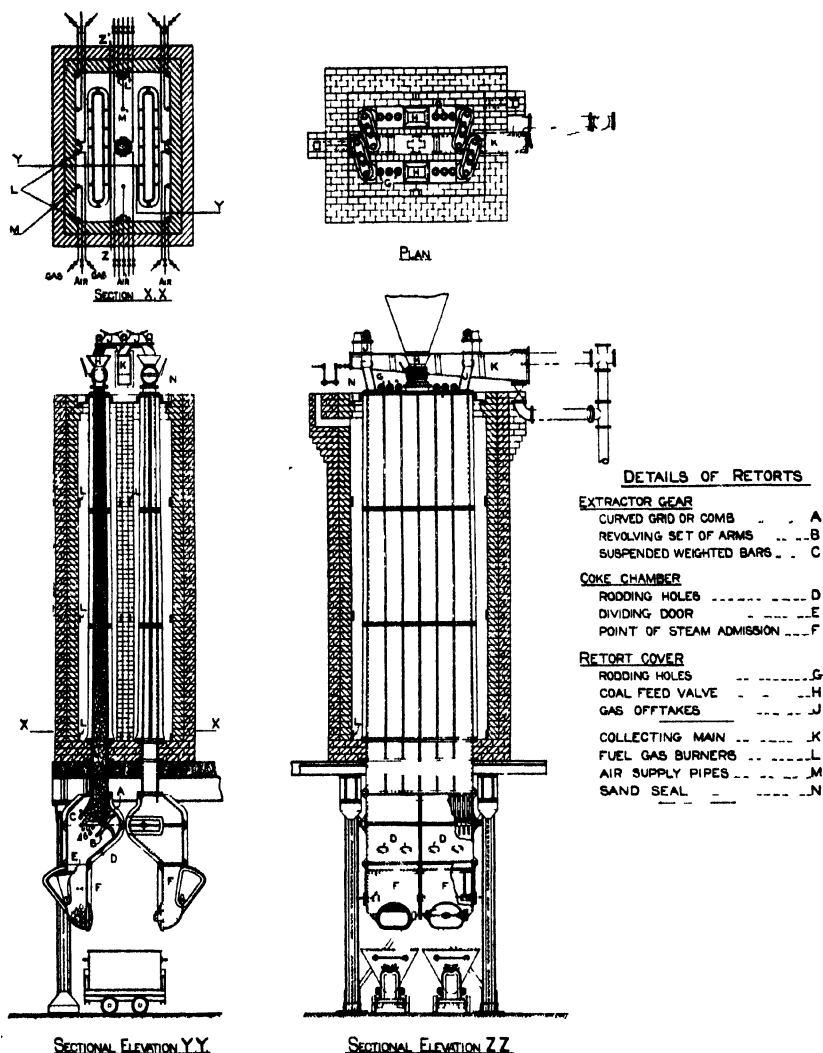
suggested ; on the other hand, at that early stage of the subject it would have been invidious to select any one proprietary process. Further, it was the policy of the Board to avoid as far as possible any duplication of work already being carried out effectively by industry.

For these reasons a small-scale horizontal setting, incorporating the method of external heating and designed essentially to meet the various ends in view, was erected at the Fuel Research Station.**

There was another direction, however, which appeared promising, but which had not been explored at the time, perhaps because it did not lend itself easily to the obtaining of patents ; and that consisted in an adaptation of the type of retort used in the Scottish shale industry, or indeed the ordinary continuous vertical retort of the gas works. After accumulating a large amount of data which was made available to other workers, from the small and intermittent plants, the first experiments in carbonisation by the method indicated were actually made in the high temperature retorts at the Fuel Research Station, the temperatures being reduced for this purpose. These further experiments were sufficiently promising to justify the erection of a setting of cast-iron vertical retorts designed essentially for low temperature carbonisation. These were of average section, 2 feet 6 ins. by 1 foot and about 20 feet in height, which was substantially the same as the high temperature verticals already mentioned. The method of heating adopted, however, was considerably modified. As low temperature carbonisation implies, there need be no straining after high temperatures in the combustion chambers. Indeed the control necessary is usually far more important in the other direction, namely that the temperature on the metal of the retort itself shall not exceed a certain limit. This limit was provisionally fixed at 650°C., but owing to troubles experienced at that temperature it has been since reduced to 625°C.

The question of the most suitable temperatures for low temperature carbonisation has been the subject of some controversy. Temperatures lower than 600°C. may give larger quantities of liquid fuels, but except with special types of coal the lower temperatures are not in general conducive to the more robust types of smokeless fuel. Values of from 600-625°C. were therefore adopted at the Fuel Research Station as being likely to give a good hard coke, and a reasonable amount of tar and rich gas. After obtaining experience of the working of the original setting of continuous cast-iron vertical retorts these were replaced by other settings, in which the cross section was considerably modified. The retorts were made narrower across their minor axis in order to facilitate heat transfer through the coal mass ; at the same time they were lengthened out along their major axis. These retorts (Fig. 6) were roughly 7in. by 6ft. 3in. at the top, widening out to 11in. by 6ft. 9in. at the bottom, and were 21ft. high. The first setting of these new retorts gave fairly good

** Report of the Fuel Research Board for the years 1920, 1921, Second Section : Low Temperature Carbonisation, pp. 21 et seq. (H.M. Stationery Office, 1922).



**SETTING OF CAST IRON RETORTS
FOR
LOW TEMPERATURE CARBONISATION**

H.M. FUEL RESEARCH STATION, GREENWICH

FIG. 6A

results, but for some time it was found impossible to reduce the breeze made to anything like a practical limit when continuous working was employed. The method of working was therefore altered, and for a time full intermittent working was resorted to, the breeze thereby being very much reduced, and the coke rendered more robust. This change, however, left the retorts exposed to the action of the incoming heat without there being anything to absorb it during the periods when they were empty between discharging and charging, and it became very difficult to ensure that the metal should not be subjected to temperatures greatly in excess of those known to cause growth and to produce other deleterious efforts. It thus soon became apparent that retorts of this type were not likely to have a reasonable life if worked on the intermittent system. A compromise was therefore tried, in which the level of the coal was allowed to fall periodically through a pre-determined distance, such, for instance, as 6 feet, every two hours, the vacant space being then immediately filled up with fresh coal. By adjusting the fall and the periods it was found that various types of coal could be worked with, and indeed successful results have been obtained over many types of coal from feebly caking to the most strongly swelling varieties. In common with most vertical retorts, these low temperature retorts worked best with nut coal. Alternatively fine slacks could be utilised, but the throughput was thereby reduced. The present method is to screen out the fines below $\frac{1}{2}$ in., which leaves a raw material ideally suited to the system. The fines can be dealt with in various ways, either by running some of the retorts with a reduced throughput, or by pre-briquetting the fines with pitch and supplying the resulting briquettes to separate retorts, or mixed in with the larger sizes of coal.

A semi-commercial battery of forty of these retorts has now been erected at the Richmond Gas Works by the Gas Light and Coke Company. (Figs. 7 and 8). In conjunction with these a setting of Hird retorts is also to be tried.

It is not necessary here to go in any detail into the negotiations which took place between the Government Departments concerned and the Gas Light and Coke Company before the arrangements were concluded for this semi-commercial trial, but it may be mentioned that Sir David Milne Watson was asked by the Government to select some one type of plant for experiment, the Government undertaking to guarantee the capital cost of the plant under the Trade Facilities Act. Under the agreement the plant would be run "as continually as is reasonably practicable" for a prolonged period in order to obtain accurate information both as to the technical and commercial possibilities of the method, the results of which would be made public.²²

Careful consideration had already been given by the Government Departments concerned some three years ago as to the best way to stimulate the development of low temperature processes in private hands. Subsidies had been

²² Report of the Fuel Research Board for the period ended 31st March, 1928, pp. 4, 22, 24, 26. (H.M. Stationery Office, 1928).

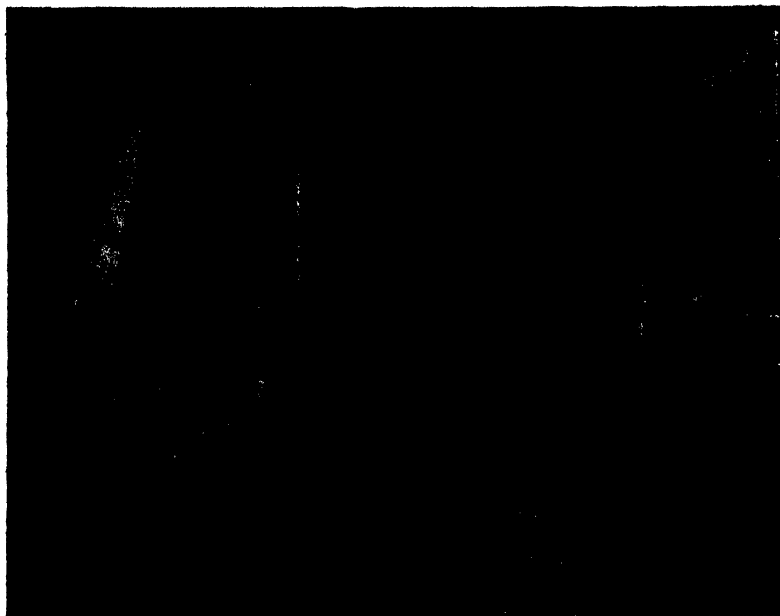


FIG. 7.

Cast Iron Vertical Retorts for Low Temperature Carbonisation under erection at the Richmond Gas Works

suggested, and various schemes mooted for this purpose. The Department of Scientific and Industrial Research was not in a position to make a close investigation of the claims of inventors or companies, but could only accept or reject such data as were given to them, basing their conclusions perhaps on a visit of a few hours' duration by a member of the staff.

The Director of Fuel Research was therefore authorised at this stage to test at public expense, and without any charge to the promoter, such plants as claimed to have reached the full unit scale, and to be capable of increase to a commercial size by mere multiplication in number. Details of the conditions under which such tests are carried out were published.¹⁴ Such facilities strengthen the position of promising plant by providing unbiased reports by an independent authority as to the working, yields, etc. under the conditions of a reasonably prolonged test. Complete independent tests of carbonisation plants had never previously been made, and it was quite obvious that the further development to the commercial scale would be considerably facilitated if such tests corroborated the claims made. On the other hand the necessity for some

¹⁴ Report of the Fuel Research Board for the period ended 31st December, 1924. Appendix III, p. 71. (H.M. Stationery Office, 1925).

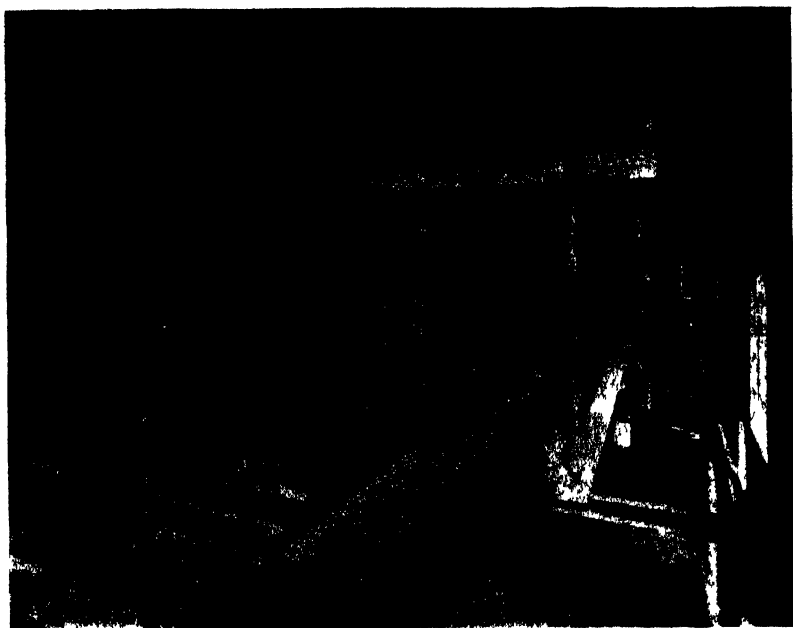


FIG. 8.

Low Temperature Retorts at Richmond Gas Works, showing heating gas supply main and pipes.

such scheme as this was made evident by the confusion resulting from misrepresentation fostered by the over enthusiasm of the inventor or promoting group. Such tests were bound to clarify the position and to accelerate the progress of the sounder methods, and indeed the results have already justified the somewhat unusual course taken.

The plants which have been so far tested and reported upon are as follows :—

Low Temperature Carbonisation Ltd. (1924).—The installation of Low Temperature Carbonisation Ltd. which was tested consisted of a battery of thirty-two retorts. Each retort was formed from a single iron casting, through which were cored twelve vertical tubes, arranged in two rows. The casting was 9ft. in height and the tubes tapered from 5½in. diameter at the bottom to 4½in. diameter at the top. A coke cooling chamber was provided for each pair of retorts. During carbonisation the retort was separated from the cooling chamber by an iron swing door operated by a wheel on the charging platform at the top of the setting. A gas-tight door allowed access to the carbonisation chamber for discharging the coke. The retorts were enclosed in a brickwork setting forming combustion spaces for the heating gas, and were therefore externally heated.

Midland Coal Products Ltd. (1925).—This plant consisted of a battery of four retorts, each consisting of a long tapering vertical cylinder having an internal diameter at the top of 4ft. 4in. increasing to 5ft. 6in. diameter about 5ft. from the bottom. The bottom section was in the form of an inverted cone, the discharging door being at the apex. The total height of the retort chamber was 17ft. A ganister brick lining 15in. thick extended over the upper 12ft., the bottom cone-shaped chamber being water jacketed. About one foot above the widest part of the retorts there was a series of twelve tuyeres through which air and steam were passed to the interior. Each retort held about five tons. The material treated consisted of briquettes made from a feebly caking coal and medium hard coal-tar pitch. Carbonisation was carried out entirely by internal heating effected by burning part of the material charged into the retort. Air and steam were passed in at the tuyeres in the vicinity of which combustion took place. The hot gas passing upward on its way to the off-take pipes served to heat the incoming briquettes. The whole of the coke made had therefore to run the gauntlet of the combustion zone.

Fusion Process. (1925).—This retort consisted of a mild steel lap-welded tube 25ft. long and 2ft. 6in. in diameter, rotating in a horizontal position within a brickwork chamber which formed a combustion space for the heating gas. The retort contained metal breakers, which may be of various types; these were not fixed in any way. Each breaker was about 20in. in diameter, and was so arranged that as it rotated within the retort it kept the wall of the latter free from scale. Ingenious arrangements were provided for ensuring gas-tight connections between the rotating retort and the stationary appliances such as gas off-takes, etc. to which it was connected.

Freeman low temperature continuous retorts. (1925).—This retort was of the vertical continuous type, and about 27 feet high and 5 feet in diameter; it consisted of six cylindrical cast-iron chambers 18in. deep placed vertically above one another. A central shaft passed through the retort and attached to it in each compartment was a circular plate which rotated with the shaft. In the chambers, fixed to the top of the chamber and the underside of the rotating plate, were two series of ploughs, which served to push the material across the tables and floors from one chamber to the next and so through the retort. There were four off-takes at regular intervals round the top of every chamber, for removing the products of distillation. The heating was effected externally by gas burners and combustion spaces incorporated within the main castings.

Crozier retorts. (1927).—This retort was of cast iron and consisted of two parallel walls 1ft. 3in. apart joined by semi-circular ends. The height of the retort was 15ft. and the greatest width was 5ft. At each of five levels were three inclined cross flues, passing through the retort from one flat side to the other. Each cross flue had a cross section of the shape formed by the intersection of two arcs at an angle of 45° , the internal dimensions being 6in. wide by 9in. deep and the external 7in. wide by 12in. deep.

The retort was enclosed in a brickwork chamber built round it in such a manner as to leave a parallel space for heating gases. This space was divided into eleven compartments or flues one above the other, separated by fire-brick tiles, but communicating with one another through ports fitted with dampers. The compartments were so built that the first set of cross flues led from the first to the second compartment, the second set of cross flues from the third to the fourth compartment and so on.

Heating gases were supplied to the setting from a furnace burning either solid or gaseous fuel and communicating with the lowest heating space.

Maclaurin retorts. (1929).—This plant was of the type in which the coal is carbonised by internal heating by the combustion of a portion of the coke. The body of each retort or producer was 20ft. high, square in cross section, and lined with 18in. of firebrick. Except for the flat walls it was in shape not unlike a blast furnace, with a maximum width of 8ft. 3in. at a distance of 15ft. from the top. The retort then tapered uniformly in both directions and was 6ft. wide at the top and 6ft. 6in. wide at the bottom. Near the base it was divided into two equal parts by a vertical wall through which ran a pair of air channels, each conducting air to a series of twenty horizontal nozzles. Facing these were similar sets of nozzles supplying air through two outside walls of the retort. Steam was supplied with the air blast in order to reduce the possibility of clinker formation and to assist in the removal of volatile products from the producer. Steam was also admitted to the base of the producer, partly to cool the coke and also to seal the base of the producer during discharge.

Tests are also in hand on the Babcock and Wilcox (Mertz cycle), the N.T.U. and the Turner processes. All the processes already tested have substantially proved the technical claims made for them, and it will be seen that they typify both internally and externally heated plants. Table III summarises the yields obtained in the tests, together with some interesting comparative data furnished by several other firms for the purposes of the Carbonisation Conference organised by the Joint Fuel Committee of the Society of Chemical Industry, the Institution of Gas Engineers, the Coke Oven Managers' Association and the Institute of Fuel, and held at Birmingham in February, 1928.

Space would not permit of a more adequate description of the individual tests, but those who desire further information will find full details both of the plant and their operation in the series of official reports published.²⁵ It should

²⁵ Report of Test by the Director of Fuel Research on Parker Low Temperature Carbonisation Plant installed at Barugh, Barnsley, at the works of Low Temperature Carbonisation, Ltd. (H.M. Stationery Office, 1924).

Report of Test by the Director of Fuel Research on Carbonisation Plant of Mydland Coal Products, Ltd., Netherfield, Nottingham. (H.M. Stationery Office, 1925).

Report of Test by the Director of Fuel Research on the "Fusion" Rotary Retort, installed at the works of Electro-Bleach and By-Products, Ltd., Cledford, Cheshire. (H.M. Stationery Office, 1926).

Report of Test by the Director of Fuel Research on the Freeman Multiple Retort of the British Oil and Fuel Conservation, Ltd., Willemsden, N.W. (H.M. Stationery Office, 1926).

Report of Test by the Director of Fuel Research on the Crozier Retort, installed by Mineral Oils Extraction, Limited, at Wembley. (H.M. Stationery Office, 1928).

A report on the test of the Maclaurin Plant will be issued shortly.

TABLE III.—LOW-TEMPERATURE PROCESS YIELDS.

Name of Retort.	Parke Process.	Midland Coal Products.	Fusion Rotar.	Freeman Multiple.	Grover Process.	MacLaurin Plant.	Leigh Smokeless Fuels, Ltd.	Illingworth Carbonisation, Ltd.	Coal Extraction Ltd.	Salemas Process.	Fuel Research.
Name of Coal.	Dalton Main.	Kirkby Top Hand.	Welbeck Cannel.	Kirkby Top Hand.	Tullygarth.	—	Caking Suitably Blended.	Rough Slack Caking.	—	Durham.	Dalton Main.
TAR—											
Yield of tar, gallons per ton	18.6	..	50.2	21.1	{16.4 2.4}	20.4 (wet)	20.0	17	..	20.3	17.3
Specific gravity	1.063	..	..	1.037	1.028	1.032	1.027	1.07	1.053	1.023	1.090
Spirit from gas, gallons per ton	1.78	..	3.7	0.85	0.80	typical tar	..	3.5	..	..	1.4
Water	..	..	..	..	..	1.70	1.5	..	..	..	..
Up to 120°	..	..	..	..	..	0.64	..	..	..	..	..
Up to 170°	..	..	..	..	..	..	..	..	..	..	..
120°-230°	4.7	..	..	6.9	4.1	..	9.5	..	6.1	7.0	3.4
170°-230°	..	..	..	..	..	5.47	1.0	..	17.2	10.9	14.7
230°-270°	14.9	..	..	9.5	11.7	14.14	7.0	..	12.9	12.4	11.1
270°-300°	12.9	..	..	13.9	11.0	..	..	..	..	..	..
270°-300°	..	..	..	..	..	..	..	..	..	..	..
270°-310°	18.1	..	..	..	15.7	..	13.0	..	..	11.2	..
270°-330°	..	..	..	..	..	26.04	..	..	..	..	23.4
270°-345°	..	26.9	..	29.8	..	..	..	..	23.0	..	..
270°-360°	..	6.1	..	..	..	..	..	..	..	..	..
Pitch	48.4	6.1	..	39.3	55.9	48.50	23.0	..	40.7	48.7	45.8
Loss	1.0	0.8	..	0.6	0.7	3.51	..	..	..	0.8	1.6
Tar acids	17.0	13.4	..	24.5	14.3	..	..	..	25.5	..	..
GAS—											
Volume of gas, cu. ft. per ton	5,620	38,300	2,740	1,720	..	33,849	10,000	6,200	3,505	3,020	5,183
Calorific value, B.T.U. per cu. ft.	700	193	1,070	895	..	239.5	350	780	814	870	719
Carbon	39.6	112.5	29.3	16.1	..	81.1	35	48.4	28.5	34.1	37.3
CO	..	1.6	6.5	10.2	..	7.0	..	..	4.5	..	4.0
CO ₂	..	..	13.2	5.4	..	0.4	..	..	5.2	..	3.4
H ₂	..	..	6.0	1.4	..	0.4	..	..	1.6	..	1.0
CH ₄	..	28.6	17.1	6.7	..	12.2	..	..	3.9	..	6.6
CnHm + 2	..	16.6	17.1	6.7	..	12.2	..	..	15.0	..	31.3
N ₂	..	4.4	49.5	59.4	..	12.9	..	..	15.0	..	10.6
" " "	..	49.3	6.3	16.8	..	46.9	..	..	14.8	..	..
" " "	1.23	..	1.59	1.1	..	..	..	..	..	..	1.27

TABLE III.—LOW-TEMPERATURE PROCESS YIELDS

Name of Retort	Parker Process.	Midland Coal Products.	Fusion Rotary.	Freeman Multiple.	Crozier Process.	Macdunn Plant.	Leigh Smokeless Fuels, Ltd.	Illingworth Carbonisation, Ltd.	Coal Ex-traction Ltd.	Salemo Process.	Fuel Research.
Name of Coal.	Dalton Main.	Kirkby Top Hards. Brquettes as Charged (from Washed Slack).	Welbeck Cannel.	Kirkby Top Hards.	Tullygarth.	—	Caking Suitably Blended.	Rough Slack Caking	—	Durham.	Dalton Main.
<i>Analyses of Coal.</i>											
Moisture	2.4	9.6	1.8	9.4	11.4 (Also charged wet weather)	10.0	Ntl	1.6	2.7	1.7	2.5
Volatile matter <i>less</i> moisture ..	35.8	32.5	46.6	32.1	34.0	33.7	31.0	33.0	14.5	32.9	32.6
Fixed carbon	57.2	52.6	36.8	51.6	44.2	50.7	62.5	54.0	78.3	60.4	58.5
Ash	4.6	5.3	14.8	6.9	10.4	5.6	4.5	21.4	4.5	5.0	6.4
Caking index	19	..	..	..	4	up to 16	caking blends	caking coal	..	caking	16
Ultimate analysis (dry coal)—											
Ash	4.75	5.94	15.00	7.73	11.77	..	..	..	..	..	6.2
Carbon	86.25	77.36	72.00	75.53	71.00	..	..	..	..	..	86.1
Hydrogen	4.95	4.91	6.35	7.83	8.00	..	..	..	..	..	5.0
Sulphur	1.10	0.96	0.78	1.56	0.80	..	..	..	..	..	1.5
Nitrogen	1.60	1.47	1.50	1.36	1.58	..	..	..	..	..	0.9
Oxygen, etc... ..	7.40	8.53	6.20	9.49	9.01	..	..	..	..	..	6.3
SOLID PRODUCT—											
Cwt. per ton... ..	13.9	..	11.7	13.3	15.4	9.9	14.0	15.2	..	15.2	15.1
Volatile matter, p. ct. ..	4.0	..	9.7	15.2	14.6	4 to 6	4.5	5 to 6	..	9.0	6.8
Breeze through $\frac{1}{16}$ in. sq. mesh ..	4.6	..	99.6	59.3	17.4	about 16 c	Ntl	5.3	..	64.8	17.2
Temperature of carbonisation, °C. 550-850	..	..	550	500	up to 770-820	..	..	600	..	450	625

be clearly understood that no attempt is made to pronounce upon the commercial possibilities of plant which may be tested. The likelihood of commercial success can only finally be judged after working a plant under a steady load for a long period, and in the light of complete knowledge of local conditions such as cost of raw material, quantity of raw material available, price and markets for products, cost of labour, etc.

It will be observed from the table that the yield of tar to be expected from low temperature carbonisation is of the order of 16-25 gallons per ton of coal, and although higher yields might be obtained under exceptional circumstances it is not likely that the figures could be increased by more than say 30 or 40 per cent. If, therefore, the conversion of a really large proportion of the coal substance into liquid fuels is sought, the aid of other processes must be enlisted. Two alternative methods which, during the past few years have been much in the public eye are the Bergius process for the direct hydrogenation of coal, and the hydrogenation of carbon monoxide produced from coal, which was described initially by the Badische-Anilin-und-Sodafabrik and followed up and extended by Fischer in Germany and Patart and Audibert in France.

The direct hydrogenation process, which consists in adding hydrogen to the coal substance under conditions of elevated temperature and pressure, has been shown by experiments both at the Fuel Research Station and elsewhere to be capable of producing from 110 to 130 gallons of distillable oil per ton of coal treated, although an additional quantity of coal may be required for power and hydrogen production.

The introduction of a solid material such as coal into a vessel containing hydrogen under a pressure of 200 atmospheres naturally presents a problem of considerable difficulty. Bergius has solved this by mixing ground coal with a liquid organic vehicle so as to form a paste which can be pumped by special appliances. To this mixture is added a small proportion of iron oxide to act either as a catalyst or as a means of removing sulphide of hydrogen in the gases evolved. In the continuous type of plant used at Mannheim and at the Fuel Research Station three reaction vessels or bombs are arranged in series, the first being maintained at about 460°—480°C., and the two final ones at about 490°C. The exact temperatures required in the final bombs are somewhat critical and depend on the type of coal used. The product leaving the last bomb is cooled and its pressure reduced in two stages, firstly to 60 atmospheres where the gas evolved is scrubbed with oil in order to extract motor spirit, and secondly to atmospheric pressure where the final crude product is collected.

The final crude product contains the whole of the inorganic matter of the coal, together with the added iron oxide and a certain amount of partially converted solid material. These solids have to be removed before distillation can be effected. A typical example of the yields per ton of coal obtained in the continuous plant (one ton per day) at the Research Station is as follows :—

YIELDS PER TON OF COAL.

Hydrogen Consumed = 114 lb.

Fraction	0°—175°	=	83 lb.
„	175°—230°	=	208 „
„	230°—270°	=	197 „
„	270°—310°	=	105 „
„	310°—360°	=	208 „
	Pitch	=	329 „
Gas Benzine		=	42 „
Bergin Gas		=	325 „
Unconverted Coal		=	363 „
Water		=	179 „
Coal Ash		=	161 „
Loss		=	154 „
			2354 „

As a general statement it will be recognised that the products from the hydrogenation of coal contain a greater quantity of saturated organic compounds than those obtained from low temperature carbonisation, and consequently the treatment of the oil from the point of purification should not be so intricate as is necessary for the treatment of low temperature tars.

It would appear that the chief value of the fractions will be either as a motor spirit or as fuel oil, although there are indications that certain of them may be of value as lubricating bases.

In undertaking hydrogenation investigations upon the coal seams in this country it has been necessary to carry out a great number of experiments in small experimental bombs. These experiments have been carried out in batches, the process not being continuous, and in attempting to correlate the results with those obtained in the continuous plant considerable differences have been encountered in the behaviour of various coals. Certain coals, for instance, which will hydrogenate readily in an experimental bomb have been found not to be workable in a continuous plant. In view of this it is apparent that an entirely false impression of the character of a coal may be obtained if the results are not correlated directly with continuous working.

In planning the investigations upon hydrogenation at the Fuel Research Station it was decided that one of the most important aspects of the problem was to determine the exact part played by the hydrogen in converting the coal into oil, and in order to trace out the effects step by step it was decided to hydrogenate coal fractionally and to interrupt the processes of hydrogenation at a series of stages. The first result of this investigation has led to a most interesting observation. It has been found that in experiments in which an

extremely small amount of hydrogen has combined with the coal the first effect is to produce a material which is fluid at the temperature of the reaction but becomes solid on cooling. This product possesses some interesting properties but it has been studied especially from the point of view of its behaviour on carbonisation. Its caking properties have been found to be much greater than those of the coal from which it is obtained, and even when the coal used is a non-caking coal the product may possess very high caking properties.

It would, therefore, appear that it is possible to confer on coals caking properties which may be in excess of those possessed by any naturally occurring coal. It has been found that as the amount of hydrogen combining with the coal is increased, the caking property is also increased, with an increase in the oil produced when the product is distilled.

The following is an example of an experiment in which the interaction of about 1 per cent. of hydrogen by weight of the coal substance gave a strongly caking product.

Conditions.

Initial Pressure Kg.p.sq.cm.	100
Maximum Pressure	245
Final Pressure	87
Maximum Temperature °C.	360
Period of Heating mins.	95

Products.

Solid gm.	218.4
Water „	22.3
Gas „	21.2
Loss „	1.6

Hydrogen Reacting.

Per cent. of dry ash free coal.	0.8
---------------------------------	-----

This observation has led to a more accurate knowledge of the part played by the hydrogen in the transformation of coal into oil, and it has been observed that in the first instance the effect of the hydrogen appears to be to eliminate oxygen from the coal substance, since a large proportion of the oxygen appears in the products from the hydrogenation in the form of water. At the same time the percentage of hydrogen present in the product is less than that found in the original coal. The phenomenon is being explored from a number of angles and it is not possible at this stage to explain fully the mechanics of the reactions. Although probably of great importance in the future, the process of hydrogenation, at any rate so far as the bituminous coals of this country are concerned,

is not able to make oil as yet at a price anywhere near that of the cost of similar fuels obtained from natural sources.

In other methods for the production of synthetic fuels from coal the first step is to break down the complicated molecules of the coal substance into carbon monoxide and hydrogen by the action of steam upon the red-hot carbonaceous matter according to the water-gas reaction



A recombination of these molecules is then effected by the action of heat in the presence of a suitable catalyst. The subsequent products range from oxygen-containing compounds such as methyl and ethyl alcohol to liquid and solid hydrocarbons, for instance, of the paraffin series.

In the process developed by Patart, water gas made from coal or coke is led through water scrubbers and sulphur purification apparatus to a gas holder.

From this it is compressed into electrically heated catalyst tubes by a compressor capable of reaching 300 atmospheres. For the production of methyl alcohol it is stated that temperatures of about 380°C. are the most suitable, while for motor fuel manufacture 450°C. is required.

In the Fischer process the combination of the carbon monoxide and hydrogen is effected at atmospheric pressure with the production of liquid and solid hydrocarbons of the petroleum series, oxygen-containing products in this case being absent.

It is evident that such synthetic processes as those described cannot be carried out without considerable thermal losses. The separate steps of a process all involve heat treatment of the material, and in converting the coal into coke and in the subsequent steps of water gas manufacture and catalytic action, some loss is inevitable. To what extent such losses will react upon the economics of the process and affect the commercial prospects of full-sized unit plants actual working experience alone can tell. High priced products such as methyl alcohol are already being made commercially by these methods, but it does not appear to be possible at present to operate such processes on a satisfactory financial basis for the manufacture of liquid fuels in this country.

THE LIBRARY.

The following books have been presented to the Library since the last announcement :—

Adams-Acton, Murray, F.S.A. Domestic Architecture and Old Furniture. London: Geoffrey Bles.

Applied Chemistry, Reports of the Progress of. Vol. 13. 1928. London: Society of Chemical Industry. 1929.

Bird, W. Hobart. Old Gloucestershire Churches. London: Ed. J. Burrow & Co., Ltd.

Brooks, C. E. P., D.Sc., and J. Glasspoole, M.Sc., Ph.D. British Floods and Droughts. London: Ernest Benn, Ltd. 1928.

Cockerell, Douglas. Some Notes on Bookbinding. Oxford University Press. (London: Humphrey Milford.) 1929.

- Coles, L. A., B.Sc. *An Introduction to Modern Organic Chemistry*. London : Longmans, Green & Co. 1929.
- Crennell, J. T., B.A., and F. M. Lea, M.Sc. *Alkaline Accumulators*. London : Longmans, Green & Co. 1928.
- Cundall, H. M., I.S.O., F.S.A. *A History of British Water Colour Painting*. Second Edition. London : B. T. Batsford, Ltd. 1929.
- Fletcher, Harvey, Ph.D. *Speech and Hearing*. London : Macmillan & Co., Ltd. 1929.
- Hartley, Dorothy, and Margaret M. Elliot, B.A. *Life and Work of the People of England: The 14th Century and the 17th Century*. Two Volumes. London : B. T. Batsford, Ltd. 1928.
- Hawkins, L. M. *Allegiance in Church and State*. London : George Routledge & Sons, Ltd. 1928.
- Hilditch, T. P., D.Sc., F.I.C. *Catalytic Processes in Applied Chemistry*. London : Chapman & Hall, Ltd. 1929.
- Holloway, Edward Stratton. *American Furniture and Decoration—Colonial and Federal*. London : J. B. Lippincott Company. 1928.
- Houstoun, R.A., M.A., D.Sc. *Intermediate Heat*. London : Longmans, Green & Co. 1928.
- Hubbard, E. Hesketh, R.O.I., R.B.A. 1. *On Making and Collecting Etchings*. Breamore : The Print Society. (London : B. T. Batsford, Ltd.). 1924. 2. *Colour Block Print Making*. Breamore : The Forest Press. 1927. 3. *How to distinguish Prints*. Breamore : The Print Society. 1926.
- Joseph, Bernard, B.A., B.C.L., Ph.D., *Nationality—its Nature and Problems*. London : George Allen & Unwin, Ltd. 1929.
- Joseph, Philip, LL.B., Ph.D. *Foreign Diplomacy in China, 1894-1900*. London : George Allen and Unwin, Ltd. 1928.
- Lister, Walter. *Practical Steelmaking*. London : Chapman & Hall, Ltd. 1929.
- Littlejohns, J., R.B.A. *Art in Schools*. London : University of London Press, Ltd. 1928.
- Lloyd, Nathaniel, O.B.E., F.S.A. *Building Craftsmanship*. Cambridge University Press. 1929.
- Lockyer, Sir Norman, *Life and Work of*, by T. Mary Lockyer and Winifred L. Lockyer. London : Macmillan & Co., Ltd. 1928.
- Lyman, Theodore, Ph.D. *The Spectroscopy of the extreme Ultra-Violet*. Second Edition. London : Longmans, Green & Co. 1928.
- Mantell, C. L., Ph.D. *Industrial Carbon*. London : Chapman & Hall, Ltd. 1929.
- Noble, Edwin. *Animal Drawing and Anatomy*. London : B. T. Batsford, Ltd. 1928.
- Oxford, *Catalogue of a loan Exhibition of Silver Plate belonging to the Colleges of the University*. Oxford : Clarendon Press. 1928.
- Pearse, A. S., and F. G. Hall. *Homoiothermism*. London : Chapman & Hall, Ltd. 1928.
- Roberts, Stephen, H., M.A., *History of French Colonial Policy, 1870-1925*. Two Volumes. London : P. S. King & Son, Ltd. 1929.
- Rowe, J. W. F., M.A., M.Sc. *Wages in Practice and Theory*. London : George Routledge & Sons, Ltd. 1928.
- Sawyer, D. D. *Everyday Art at School and Home*. London : B. T. Batsford, Ltd. 1929.
- Smith, Neil Skene, B.Com. *Economic Control*. London : P. S. King & Son, Ltd. 1929.
- Stephenson, James, M.A., M.Com., D.Sc., *Bedrock of Modern Business*. London : Sir Isaac Pitman & Sons, Ltd. 1929.
- Strzygowski, Prof. Josef. *Early Church Art in Northern Europe*. London : B. T. Batsford, Ltd. 1928.

- Taylor, Frederic H. *The Installation of Electric Lighting and Heating.* London: Chapman & Hall, Ltd. 1928.
- Tinkler, C. Kenneth, D.Sc., and Helen Masters, B.Sc. *Applied Chemistry.* Vol. 1. Second Edition. London: Crosby Lockwood & Son. 1929.
- Todd, Dorothy, and Raymond Mortimer. *The New Interior Decoration.* London: B. T. Batsford, Ltd. 1929.
- Villiers-Stuart, C. M. *Spanish Gardens.* London: B. T. Batsford, Ltd. 1929.
- Wall, E. J., F.C.S. *Practical Color Photography.* London: Chapman & Hall, Ltd. 1929.
- Woodhouse, Thomas, and Peter Kilgour. *Jute and Jute Spinning.* Two Vols. London: Macmillan & Co., Ltd. 1929.

NOTES ON BOOKS

HOMIOOTHERMISM. *The Origin of Warm Blooded Vertebrates.* By A. S. Pearse and F. G. Hall. New York: John Wiley & Sons, Inc. London: Chapman and Hall, Limited. 10s. net.

The authors give to the main-title, "Homoiothermism," a rather notable prominence, this expression being the only indication as to subject matter on the outside of the book, on the half-title-page, or as a running title over the alternate pages. Taken alone we can imagine it as a possible, but rather far-fetched title for a treatise on Kelvin's principle of energetic dissipation; but a careful reading of the whole book shows the volume itself as strictly true to that sub-title which we find but once printed in very small type on the main title page, and which we give above. As a study of the probable evolutionary origin of the higher vertebrata, the book deserves special notice.

The treatise opens with a study of conditions for an optimum vital metabolism, as affected by temperature; all higher vertebrates depending on cells that "live at a rather constant temperature"; this temperature being "close to the optimum for their special metabolic activities." The authors point out that C. Lusk suggested, in his study on nutrition, that constant-temperature vertebrates "originated along the shores of tropical oceans, which continually had a rather high temperature, to which these animals gradually became adjusted." (p.2 and p.108.)

Characteristics of animals that, when in health, live at a "rather constant" body-temperature, like birds and mammals, are contrasted with the low-temperature vertebrates, which often tolerate, or even seek such high temperatures as raise the body temperature considerably; sometimes as high or even higher than the body-temperature of a bird or a mammal. Very varying aspects of tolerance are considered in Chapter IV, where, on p. 18, is a closely printed tabulation of the body-temperatures in representative lower animals, which are characterised not only by being cold-blooded in comparison with birds and mammals, but which are inconstant as to temperature in the sense that their vital metabolisms can function, despite a wide range of body-temperature, without death from cold or death from fever resulting. These inconstants as to temperature are all animals below birds and mammals; indeed the medusa, with a body-temperature about one-fourth of a degree over the environment (Valentine), heads the list. The oyster is quoted as having a body-temperature "the same as the water" and a normal vital range of body-temperature of 82 degrees F. (Davy); a range only exceeded in the tabulation by certain amphibia: 86 degrees. The frog closes the tabulation; Berthold being the authority for stating that when in water its temperature is that of the water.

Chapter V is headed "Responses of Homoiotherms to Variations in Temperature."

In the first few lines of this Chapter we are reminded that the average body-temperature of all mammals is about 39 deg. C.; of man about 37, and of birds about 44. A graph on p. 31 shows at a glance all the fundamentals, while the final two paragraphs of the Chapter indicate briefly those principles of temperature regulation in the higher grades, which are afterwards considered under various headings; as for example, "Mechanisms of Temperature Regulation," p. 56, "Effects of Decerebration and Spinal Sections on Thermo-regulation," p. 64, "Fever," p. 66, and "Fitness of Temperature Constancy," pp. 89-95.

The main ideas are easy to grasp, as they are given without an overburdening bulk of historical matter; the older Evolutionists from Empedocles to Charles Darwin being practically neglected, except by tacit acceptance of main features; but Sir George H. Darwin (fourth in the illustrious sequence of five Darwins) is specially mentioned and considered in Chapter II, "Temperature of the Earth in Time and Space." The earth and the individual seem linked into kinship, perhaps rather hastily, by a suggestion on p. 90, due to Macallum, that when the protovertebrate types first acquired a kidney, the degree of salinity or osmotic pressure of their blood corresponded with that in the ocean of the time and place.

This leads us to Erasmus Darwin, who from the standpoint of evolution may be termed Darwin I in the sequence of five. The best edition of his last book, "Origin of Society," by the sub-title, or "Temple of Nature" by the first or main title, is the octavo edition printed at Glasgow by the University printers and dated 1825, or about 23 years after the issue of the first edition and the death of Erasmus Darwin. Here the warm ocean in which organised vitality is supposed to have had its origin is regarded as saltless or nearly so, like our ordinary water supplies; saline impurities having drained into the ocean slowly and irregularly. Darwin's "Origin of Society" is the first systematic, detailed and consistent work in which bodily man, his mentality and all his works, are displayed as in sequence to natural laws, or as "images of the operations of nature." The quoted words occur in Darwin's short preface to the first edition, dated from the "Priory near Derby, Jan. 1st, 1802." The death of Erasmus Darwin took place on April 18th following.

Much that bears on the volume under notice is in Erasmus Darwin's "Origin of Society." A footnote on Darwin's p. 56 touches on increase generally; especially in the mass of the earth, and so is partly in unison with Chapter II of the volume under review, which includes the speculations of Chamberlain and of Darwin IV, (George H.). Darwin I seems to think that our earth has increased by many additions coming to a somewhat irregular granitic mass surrounded with water, so as to form an unbrokenly tidal spheroid like that imagined by Habbage; see p. 248 of the 1838 edition "Ninth Bridgewater Treatise." Erasmus Darwin, in his *Origin of Society*, emphasises the warm ocean as indirectly building the cretaceous and magnesian hills, also the vertebrates until "Cold gills aquatic form respiring lungs." On p. 56 the principle of universal law is considered by Darwin as under Nature's Lord, who:--

"With heat and light revives the golden day,
And breathes his spirit on organic clay;
With hand unseen directs the general cause
By firm, immutable, immortal laws."

As an easy suggestive, carefully accurate, and lucid study of heat, matter and law in what is generally now known as evolution, the work under review deserves a wide circulation in edition after edition; but we hope the ill-fitting combination "Homiothermism" may in some way be eliminated, so that one may quite unfetteredly think and speak of the book as "Pearse and Hall on the 'Origin of Warm Blooded Vertebrates.'"

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4006.

VOL. LXXVII.

FRIDAY, AUGUST 30th, 1929.

*All communications for the Society should be addressed to the Secretary, John Street,
Adelphi, W.C.(2.)*

NOTICE.

EXHIBITION OF INDUSTRIAL DESIGNS.

The Exhibition of work selected by the Judges at the Sixth Annual Competition of Industrial Designs, which has been on view by kind permission of the Board of Governors, in the Exhibition Pavilion of the Imperial Institute since August 3rd will be closed on September 1st.

The Exhibition is open free of charge, and no tickets are required. It includes designs for Architectural Decoration, Textiles, Furniture, Book Production, Pottery and Glass, Posters, Showcards, etc.

The Exhibition has been visited by many manufacturers and others specially interested, and also by the general public. A considerable number of designs have been sold.

PROCEEDINGS OF THE SOCIETY.

SHAW LECTURES.

THIRTY YEARS' EXPERIENCE OF INDUSTRIAL MALADIES.

By SIR THOMAS MORISON LEGGE, C.B.E., M.D.,
late H.M. Senior Medical Inspector of Factories.

I.

NOTIFICATION OF INDUSTRIAL DISEASES.

(Delivered February, 1929.)

After twenty-seven years work in the Factory Department and comparison of the conditions then in factory and workshop with those which exist to-day I am amazed with the progress made in the interval. Perhaps it is most

noticeable in illumination and locally-applied exhaust ventilation. In the early days I used to see rooms warmed by lighting gas jets and a naked bat's wing flame on a moveable bracket was the means of illumination to a lathe or loom. When I visited all the white lead works in 1899 in only two of the twenty-three was there a vestige of a primitive form of exhaust ventilation for the removal of dust. So it was, too, in the 860 brass foundries in Birmingham when I visited some of them in 1903 on the quest of those suffering from brass founders' ague. Now every white lead factory is equipped with a system of locally-applied ventilation, and the conditions in brass-casting workshops from somewhat similar provision are vastly better than those I can remember. But more important than that is the spirit of invention in the trades themselves in the discovery of labour-saving devices.

I willingly and readily give praise to the unknown public behind the Home Office for the urge and movement which it has set going. Although the powers that be there may appear to be slow and tardy in their consideration of reports and in action upon them, the wheels grind fairly surely and finely in the end. To an impatient and impetuous person like myself (and if so to me, how much more to workpeople who cannot realise the difficulties on one side and another!) the delay of one year, two years, or often much longer in fulfilment of what at first sight seems so obvious, is hard to bear. But I am convinced that long consideration given to a subject which is to be dealt with lastingly is right and makes the chance of success greater. Time is so short that it is an unimportant factor compared with a happy and unanimous ultimate solution. Perhaps it will be so with one or other of the Factory Bills in God's good time!

I am here talking only of matters with which the Home Government is concerned, and not with international agreements or conventions, where we have not been so successful—at any rate in carrying them out.

Many of the subjects dealt with have been and are extraordinarily complex and difficult. Take, for instance, two only—silicosis and skin cancer. Thirty years ago the public conscience was stirred about lead poisoning and "Phossy jaw." We have, however, dodged phosphorus necrosis, and we know, at any rate, how to deal with practically all the manifestations of lead poisoning, although this is not the same thing as saying that we have always acted accordingly. And so in time will it be with silicosis and skin cancer. The second will be more easily dealt with than the first and probably by the experimental finding of an oil which is free, or can be freed, from the carcinogenic properties present in lubricating oil as used to-day. It may take a long time to find, but that it will be found eventually I have no doubt. Silicosis is more difficult to tackle. Substitution of artificial stones composed of *silicates* (carborundum, etc.) is one partial solution in the grinding industry, and, failing that, sluicing the stone with water to an extent that has not been done before is another. Meanwhile effort to stop the dust in one way or another, must be the main safeguard.

Throughout these lectures I shall lay stress, as a kind of test, on three axioms which experience has led me to enunciate. They are:—(1) Unless and until the employer has done everything the workman can do next to nothing to protect himself. (2) If you can bring an influence to bear external to the workman (i.e., one over which he can exercise no control) you will be successful; and if you can't, or don't, you won't. (3) All industrial lead poisoning is due to the inhalation of dust and fumes; and if you can stop their inhalation you will stop the poisoning. It is not due to dirty hands (i.e., eating with unwashed hands).

Examples of the influences I have in mind are:

- (1) Prohibition, e.g., by the substitution of sesqui-sulphide of phosphorus for yellow phosphorus (effected by the Berne Convention).
- (2) Conversion of pulp white lead into oil paint ready for the market in automatic closed-in machines without dry grinding.
- (3) "Low solubility glaze" in pottery manufacture, by which the same amount of raw carbonate of lead may be used, but so combined in calculated quantity with siliceous material in a "frit" as to be practically insoluble in the gastric juice.
- (4) Plastic rubber, that is, rubber in which lead oxide has been incorporated in a "mother batch" to the extent of 90 per cent., thus abolishing production of lead dust in later processes (first put into practice by Mr. C. A. Klein, Chemist to the Associated Lead Manufacturers Ltd.).
- (5) Disinfection of anthrax-infected wool by formaldehyde—the Duckering process—as carried out in the Government Wool Disinfection Station, (Home Office) Liverpool; and finally, though not quite so successfully,
- (6) Locally-applied exhaust ventilation by a fan.

Examples of influences, useful up to a point, but no remedy, which are not external, but depend on the will or whim of the worker to use them, are respirators, gloves, goggles, washing conveniences and waterproof sand-paper.

In the expiring hours of the Rosebery Government, after its defeat, Mr. Asquith, the then Home Secretary, placed the Factory and Workshop Act, 1895, on the statute book, section 25 of which called on every medical practitioner attending on or called in to visit a patient whom he believed to be suffering from poisoning by lead, phosphorus or arsenic, or from anthrax contracted in a factory or workshop, to notify it to the chief inspector of factories at the Home Office. A similar duty was imposed on the occupier to report every case to the inspector of factories and to the certifying surgeon. A further subsection gave power to the Secretary of State to add other diseases to the list as, and when, he thought necessary. In 1901 mercury poisoning was added in consequence of incidence in hatters' furriers' workshops and in the manufacture of thermometers. More recently, in 1917, toxic jaundice from tetrachlorethane and trinitrotoluene (T.N.T.), or any other poisonous substance, was added on account of the mass poisoning from them among aeroplane and munition workers.

The reason why a symptom, toxic jaundice, and not poisoning by the substances in question, was asked for I will explain later. Still more recently, in 1920, epitheliomatous ulceration due to tar, pitch, bitumen, mineral oil or paraffin, or any compound, product or residue of any of these substances, and chrome ulceration, were added, and finally, on December 31st, 1924, poisoning by carbon bisulphide and aniline and chronic benzol poisoning became notifiable.

Soon after the 1925 Act was passed a medical man was appointed, fortunately, as Chief Inspector of Factories in the person of Dr., now Sir Arthur Whitelegge, K.C.B. I tremble to think what would have happened had the administration of section 25 remained in lay hands. Although I was not appointed the first medical inspector of factories until June, 1898, I can remember the publicity given to the prevalence of lead poisoning in the Potteries and White Lead Works, involving in some cases permanent blindness, convulsions and wrist drop, and to the concealment of cases of "phossy jaw" in the manufacture of lucifer matches. Indeed, it is an ill wind that blows nobody any good, and these terrible facts blew me into the Factory Department, to follow up the cases.

The statistics of notifiable diseases were in a state of chaos. I will let you into the secret of why the detailed figures commence in 1900 and not, as they might be expected to do, in 1896. I discovered that in the Division which included the most important white lead works the notification by the medical practitioner was treated as one case and the report upon it by the Certifying Surgeon as another, so that the number was doubled. I realised that unless the closely-scrutinised official figures were, like Cæsar's wife, above suspicion, there would be no end to the trouble. Consequently, stringent rules were drawn up for keeping them. No case of lead poisoning was included more than once in each year—second notifications being probably due to relapse or incomplete recovery from the first attack.

In form there is close similarity between this section dealing with industrial diseases and that in the Infectious Diseases (Notification) Act requiring the medical practitioner and the householder to notify the medical officer of health of every case of scarlet fever, diphtheria, &c. It is common knowledge that as regards the householder this enactment has been allowed to become a dead letter or, rather, to be held only as a sword of Damocles over his head, in the presence of flagrant exposure of himself or his child when suffering from infectious disease, because he is thereby credited with medical knowledge which cannot be expected of him. The case of the occupier of a factory is, perhaps, not quite on all fours with that of the householder because, employing people for his own profit on work in which exposure to poisonous substances is incidental, his duty to take precautions is apparent and, should injurious effects show themselves, his share in the responsibility for this must, within reason, be brought home to him. A defect in the section to my mind is that notification by the medical practitioner has to be made to a layman. It was a fortunate accident that Sir A. Whitelegge was a medical man. Industrial

diseases should be notified to the Senior Medical Inspector of Factories—or Chief Medical Inspector of Factories as he is in everything but the name—who is in the same plane as his informant and can enter into his mind. Fancy the medical practitioner having to notify infectious maladies to the town clerk !

Are there any other forms of poisoning or any other industrial diseases which should be added to the list ? The object of notification is not primarily to obtain statistics in the same way as devolves upon the Registrar General, but to obtain a clue to conditions over which the inspector can exercise control. Publicity, too, from the requirement to report cases is a salutary means of effecting, often enough, improvements in working conditions. I cannot say what strange new potent agents the chemical industries have in store for us, but at the moment I should say there would be advantage in including in the list chronic poisoning from hydrogen sulphide gas and dermatitis due to dust and liquids, expensive though the latter would prove to be.

Notification of industrial disease is more difficult than is notification of infectious disease. One difficulty the medical man is faced with is that, with the exception of anthrax, the poisonings he is expected to notify do not present the same unequivocal signs that acute infectious diseases like smallpox or scarlet fever do. No absolute definition of what constitutes industrial poisoning is possible, and each practitioner in reporting what he "believes" is one, must form his own standard in the same way as he forms his own standard of what constitutes ptomaine poisoning or fish poisoning. The point is that, owing to the slow onset of these insidious, industrial maladies, the patient passes through a stage of absorption which does not amount to poisoning and yet in which the stigmata of the particular compound—the blue lines on the gums from lead, the tremor from mercury, the cyanosis from aniline—are apparent. The medical practitioner has, therefore, in the first place, to make a differential diagnosis between the symptoms in lead poisoning, let us say, and the commonest everyday ailments—headache, anæmia, stomach-ache, rheumatism ; and, secondly, he has to make up his mind whether absorption is so advanced as to have exploded in acute or chronic poisoning. Common sense, however, dictates the desirability of fixing in some way the degree of severity of symptoms which should lead to notification, and few medical men probably would deny that, generally speaking, any symptoms necessitating absence from work and appeal to a doctor for treatment constitute sufficient grounds for notification.

But the mere presence of symptoms requiring medical assistance may not be all that is necessary to settle the question of notification. Take, for instance, T.N.T. poisoning. During the war it showed itself in the most protean way, first as a dermatitis, to which nearly all those coming into contact with it at first succumbed ; secondly, as a gastritis ; thirdly, in effects on the blood (formation of methæmaglobin, with consequent reduction of its oxygen-carrying power) ; fourthly, in specific destruction of the liver cells characterised

by jaundice and atrophy of the liver—a very grave condition ; and fifthly, in the rare form (always fatal) of aplastic anæmia, characterised by destruction of the red marrow of the bones with resulting great diminution in the number of red and white blood cells. These various symptoms are by no means always distinct from one another. With exception of the first, they are all to be described as T.N.T. poisoning, and they may merge one into the other—cyanosis may be present with gastritis or toxic jaundice ; jaundice may be present with aplastic anæmia—they may be interchangeable or concomitant manifestations of the same poison. I have mentioned them all separately in order to insist that, for the purposes of statutory notification, all the forms are not equally important, although obviously the management of a factory ought to be aware of all cases. But when statutory notification has to be made, the medical practitioner and the occupier require a definite symptom to guide them. Publication of statistics of notification of tetrachlorethane poisoning or of T.N.T. poisoning during the war would have been unreliable as they would have simply referred to the number of workers coming into contact with tetrachlorethane in aeroplane works or T.N.T. workers in munition factories, of whom there were thousands and thousands, who sought medical treatment for any and every complaint. But figures published monthly in the *Labour Gazette of toxic jaundice* furnished a real indication of serious illness calling in each case for inquiry and report on observance of precautions in the particular process at which the affected person was employed. This was the procedure adopted. It reduced expense to the State, relieved the medical man and occupier of doubt as to when to notify, and saved endless worry and waste of time which would have resulted had a wider requirement been imposed. With the termination of the war the situation altered. Return to normal use of T.N.T. removed the fear of being snowed under with notifications, even if information was thus received of any one of the symptoms named, and so now opportunity for this has been given by the requirement to notify *aniline poisoning* signifying the symptom complex which the Germans describe as “Anilismus” and the French as “Anilisme.”

PRINCIPAL RESULTS ACHIEVED.

Now, what are the principal results obtained from notification ? Look at this Chart of the cases and deaths of the 11 notifiable diseases and poisonings from the years 1900 to 1928 inclusive.

The Chart is given to impress the eye by the peaks, the precise number of the cases and deaths for each year appearing in Appendix I. Each of the small squares represents an inch, with sixteen cases in each. Black represents the cases, grey (red in the original diagram) the deaths. The four years 1915-1918—the years of the war—were coloured green in the original diagram and in the chart show grey.

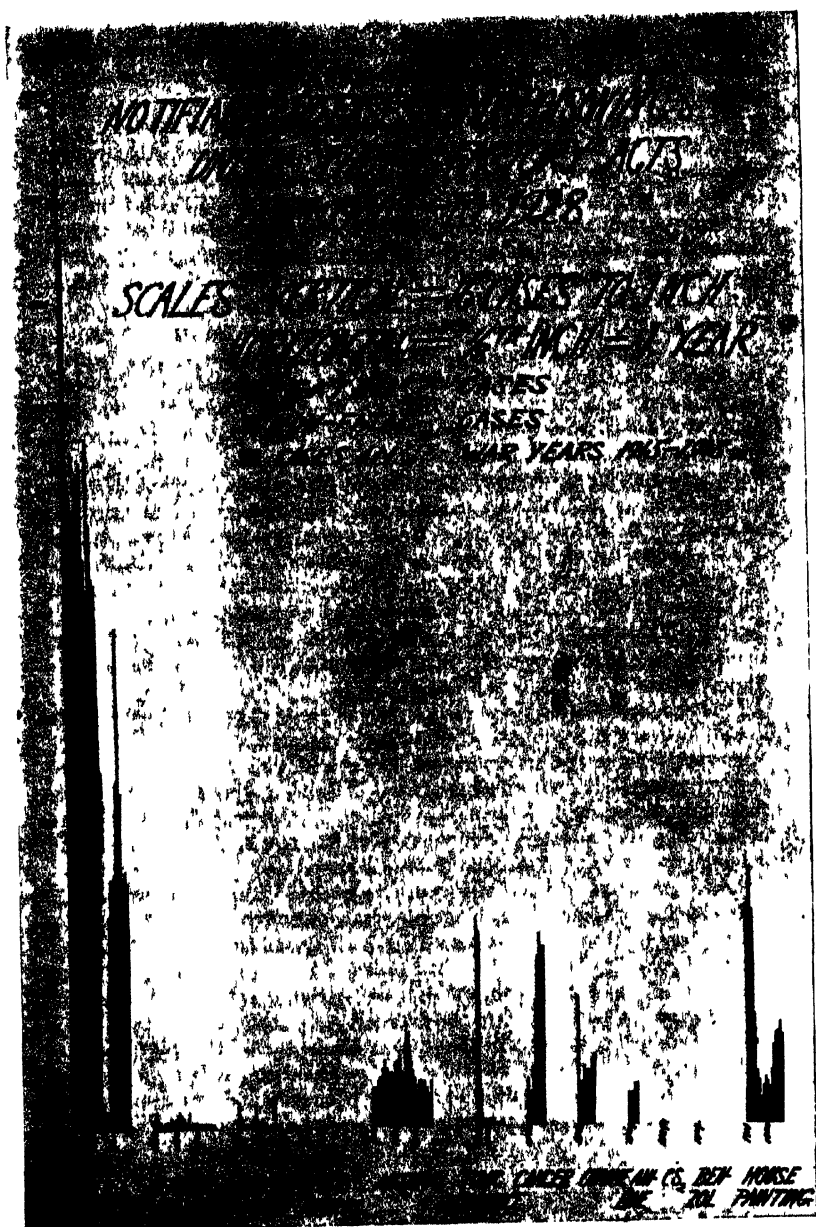


CHART I.

You observe how lead poisoning dominates the picture and how negligible, comparatively speaking, appears poisoning by mercury, arsenic and, indeed, all the others, until you begin to read between the lines.

With *mercury poisoning*, for instance, as it occurs from inhalation of the fumes given off in the manufacture of clinical thermometers, and from the gradual absorption of the metal through the skin of the workman's hands, on which tiny droplets can be seen through a magnifying glass, for one case notified you will find in the shop perhaps twenty showing slight tremor, hesitation in speech, a flabby, indented tongue, coated teeth, slightly spongy gums and salivation pointing to absorption all the time of infinitesimal quantities of mercury. If you come up behind them and surprise the worker by a tap on the shoulder he will start as though he mistook you for a policeman—an indication of mercurial erythism. Similarly is it with the hatters' furriers, who inhale the floating particles of rabbits' fur which has been "carotted," i.e., brushed with a solution of nitrate of mercury and thus becomes the vehicle for conveying the metal. Mercury poisoning, however, affords a magnificent example of invention—discovery of methods external to the workman removing the danger. The account we read of in Bernardino Ramazzini's book on the Diseases of Tradesmen, published in 1703, of mercurial poisoning in the Middle Ages shows it to have claimed far more victims than it does to-day. And why? Because the goldsmiths and silversmiths used an amalgam of mercury with gold and silver—watergilding—to decorate the ornaments they made and, to leave the precious metals behind, the mercury was volatilised by heat over a fire with evolution of toxic fumes. Mirrors, similarly, were backed with the same amalgam with terrible results to those who practised it in Fürth in Germany.

The introduction of electro-plating, largely due to Wright and the Elkingtons in the 'forties, and the nitrate of silver and ammonia process for the backing of mirrors, following on an experiment by J. von Liebig in 1835, have reduced mercury poisoning to very small proportions. And mass production of clinical thermometers by methods involving next to no handling and exposure to fumes will probably rob it still further of its terrors. Because mercurial poisoning is a very unpleasant form of poisoning.

Arsenic poisoning, although apparently so trivial in numbers, is industrially as interesting as is the criminal administration of its salts, although for quite other reasons. And the symptoms bear little resemblance to one another. Arsenical poisoning industrially occurs in two quite distinct forms: (1) from inhalation of, or contact with, the dust of salts of arsenic, showing itself in skin eruptions, especially where the dust, say, of emerald green or sheep dip "flies" and alights on folds of the skin, or on moist surfaces like the groin; and (2) from inhalation of arseniuretted hydrogen gas, showing itself most dramatically in the development of a coppery jaundice and hæmaturia owing to the fact that the gas is the most powerful destroyer of the red blood cells.

You can never get rid of the irritation set up by arsenical dust unless you can find a means external to the workman, clothe and protect them with respirators, etc., however completely you may try. Fortunately travelling belts, automatic packing machinery, combined with locally applied exhaust ventilation, have done the trick, as the reduction in the number of cases shows. The little peak in 1917 is due to cases arising from the manufacture of arsenic trichloride, which was used as a poison gas.

Phosphorus poisoning, the horrible redoubtable "phossy jaw," is now only of historical interest, since practically all the civilised countries (commencing with Denmark) have bound themselves to observe the terms of the Berne Convention of 1906 prohibiting the use of white phosphorus in the manufacture of lucifer matches.

Here a word will be apposite on the subject of prohibition. Many people—generally those who approach the subject on theoretical rather than practical grounds, or who have not themselves to handle, say, a dangerous material—take the view that prohibition is a confession of failure, like the extraction of a tooth, or amputation of a limb, to be adopted only when less severe methods will not save the situation as, *e.g.*, by Regulations. I have heard woolbrokers say, for instance, "We must bear with anthrax." I held this view myself once, and especially in the matter of the regulation of the use of phosphorus, before I realised the importance and the truth of my dictum that only an influence external to the workman brought to bear will remove the danger. Because when we thought the manufacture was safeguarded by stringent regulations as to locally applied exhaust ventilation, periodical dental examination, prohibition of employment after extraction of a tooth, etc., unfortunately some unforeseen loophole remained *e.g.*, the surreptitious visit to a dentist without saying anything about it and immediate return to work with subsequent development of necrosis of the jaw starting in that very tooth socket. And when the brilliant discovery of a substitute for white phosphorus in the sesquisulphide was made in France, the manufacturers themselves confessed they would rather accept prohibition than have to put their heads in the noose of almost impossible restrictions. And will it not be the same in regard to the prohibition of the use of white lead in the internal painting of buildings?

Of all industrial maladies, *anthrax*, ridiculously small in the number of cases and deaths, when compared with measles, for example, holds out the greatest terror for the workman in those branches of industry in which it is prone to occur. (Chart II.) It always makes a frontal attack and is, in this respect, a splendid antagonist, so different from lead poisoning and fibroid phthisis—slinking and slow diseases, taking years to develop and incapacitate. For anthrax a fortnight is time enough for either a cure or a kill. And anthrax is no respecter of persons; the very strong and robust succumb as readily as, if not more readily than, the weak. I have had many strange experiences with anthrax, and if I were superstitious, and had lived in the Middle Ages, I should



CHART II.

have burnt many a candle at the altar of St Blaise, the patron saint of the woolcombers, as shown in a stained glass window in Oxford Cathedral, to protect me from the demon of anthrax. The disease is due to a bacillus which attacks hoofed animals—horses, goats, cattle, sheep and pigs—but not fur yielding animals, and from the fleece or hides of animals which have died of the disease in any part of the world—and in many parts it is far more prevalent than in this country—it may be conveyed to man. The blood of an animal dead of anthrax teems with bacilli which, as soon as they come into contact with the oxygen of the air, become converted into spores indestructible except by steam, boiling water or certain chemicals. Dr J. H. Bell, of Bradford, was the first, in 1878, to prove the identity of the disease in animals and man. Anthrax is a world-wide question. Only two ways of mastering it are possible. One is to prevent animals contracting the disease by use of Pasteur's method of vaccination. Could this but be done it would be splendid, because it would protect both animals and men, but who imagines that inoculation of the herds of sheep and goats in Asia Minor, Persia, India, Thibet, or of the horses in Manchuria, or the cattle and buffaloes in Africa and the Straits Settlements and China, or the Alpaca sheep in Peru, is practicable?

The other way is disinfection of particularly dangerous classes of wool, and here magnificent work has been rendered, after some 130 experiments, in the working out of an influence external to the workman which not only promises but gives success, by G. Elmhirst Duckering, an Inspector of Factories and now the Director of the Government Wool Disinfection Station in Liverpool.

This station is the outcome of his own inventiveness, and has been built, including the machinery, from his own designs.

The method is simplicity itself, the principle underlying it being first a preliminary soaking of the wool in warm soap and water (presumably to convert the spores into bacilli and so render them more easily destructible) and then, when naked and freed from dirt and grease, passing the wool through a warm 2½ per cent. formaldehyde solution. This process has removed the nightmare of anthrax in Bradford which hung over the prosperous city for decades.

Horsehair can be similarly successfully treated. But properly spread out (in doing which danger is incurred) exposure to steam, preferably at a temperature of 225° F., is also effective.

A point to note also about the anthrax figures is that the number of cases in wool has not diminished in the same proportion as the number of deaths. Thus the mortality has steadily fallen from 29.6% in the quinquennial period 1899-1904 to 13.6% in that of 1920-1924—more than one-half. This is due partly to earlier diagnosis in the first critical days, but mainly to the treatment (without excision) by means of Sclavo's anti-anthrax serum combined with physiological rest—a method which Dr. Eurich has successfully practised at the Bradford Royal Infirmary, has been carried out also in the heavy woollen district of Dewsbury and is generally the approved method now in all large hospitals.

Toxic jaundice, with its sudden rise and equally remarkable fall and attendant high case mortality of about 33 per cent., is very remarkable. The fall is due to the fact that the *extraordinary* use of T.N.T. ceased after the war. But even if it had continued we should have been able to watch it with complacency, as its mode of entry into the system had been discovered and means, external largely to the worker, found to combat it by mechanical methods of filling shells. In 1903 Dr Prosser White of Wigan and Dr. John Hay of Manchester, experimenting on themselves, showed how rapidly dinitrobenzol passed through the skin into the blood. In the early stages of the war this marked effect of the nitro and amido derivatives of benzene were rather lost sight of, in view of the obvious presence of much dust and fume, until the late Dr. Benjamin Moore, experimenting on himself with amatol (a compound of T.N.T. 20%, and ammonium nitrate 80%) showed how readily absorption through the skin could take place, as I had always maintained. Once this fact was recognised, introduction of mechanical means of filling shells in place of hand-filling quickly brought about a reduction.

Of *Epitheliomatous ulceration* (skin cancer) and *chrome ulceration* I will speak together, to bring out the striking difference between them. Both were made notifiable in 1920, and the figures in both stand rather high. But why in the case of chrome is there not a single death and why in that of epitheliomatous ulceration is the death rate so high (some 33 per cent.)? That is because coal tar and mineral oil and certain of their derivatives exert a carcinogenic effect

on the epithelial cells and chrome does not. No complete influence external to the workman can stop chrome ulceration, but watchfulness, and first-aid treatment will alleviate and hold it in check. Skin cancer on the other hand will be got rid of in the course of years to come by either the elimination in the tar and mineral oil of the not-yet-discovered carcinogenic substances, or by their neutralisation or destruction. It has, indeed, already been shown by Twort,¹ working in Manchester, that "the carcinogenic activity of an oil is much reduced or completely removed by extraction with sulphuric acid or by oxidation and by reduction." I believe the incidence (about 9 cases every month) of skin cancer among the 33,000 mule spinners in Lancashire of 25 years of age or over results, as my former colleague Dr. Henry² has gone a long way to prove, from the gradual change-over in the 'sixties and 'seventies from animal and vegetable to mineral oils, for the purposes of lubrication. A good deal can be read into the Chart III. or perhaps better with the Table of figures on which the Chart is constructed* :—



CHART III.

Agent.	Industry.	1920	1921	1922	1923	1924	1925	1926	1927	1928	Total.
Pitch and Tar	Patent Fuel ..	30	17	19 ¹	14 ¹	11	25 ⁵	27	20	20	183 ⁵
	Tar Distilling ..	4	9 ⁸	6	14 ¹	15 ³	23 ⁴	18 ³	14 ¹	23 ⁴	126 ¹³
	Gas Works ..	4 ¹	4	2 ¹	6 ¹	1 ³	9 ³	15 ³	14 ⁵	17 ¹³	72 ²⁴
	Other ..	4	2	—	2	4 ¹	6	16 ³	10 ³	8 ³	52 ³
Paraffin	Shale Oil ..	3	—	5 ¹	6	2 ¹	4	2	6	2 ¹	30 ³
Mineral Oil.	Mule Spinning	—	—	—	15 ¹	79 ¹⁷	78 ²⁵	88 ²⁶	101 ²¹	101 ²⁶	462 ¹⁴⁰
	Other ..	—	—	—	1	11 ¹	15 ¹¹	21 ¹⁵	9 ³	4 ³	61 ²⁶

The principal figures relate to cases, the raised figures to deaths.

¹ C. C. Twort and J. D. Fulton, *Journ. of Path. and Bact.*, Vol. XXXII., 1929 p. 161.

² "Mule Spinners' Cancer: the time necessary for its production" by S. A. Henry, *Journ. of Hyg.*, Vol. XXVII, August, 1928.

* *Conf. on Cancer*, London, 1928. Paper by J. C. Bridge and S. A. Henry.

The percentage of deaths to cases is low—not 3 per cent. among patent fuel workers, higher among the tar distillers, about 9 per cent., still higher among the cotton mule spinners, about 33 per cent., and over 47 per cent. among the retort house and pitch diggers in gas works. Why are there these differences? The difference in carcinogenic potency in tar, pitch and mineral oil, as used in these industries, does not account for it. The reason, in my opinion, why the proportion of deaths to cases is so astonishingly high among tar distillers and gas workers as compared with patent fuel and shale oil workers is simply due to the fact that only a fraction of the cases is being reported in the former, whereas we hear of nearly all in the latter. The patent fuel and shale oil industries are concentrated in particular areas and so the malady has become known to workpeople and the medical profession, and this has led to prompter recourse to treatment *in the early stage of the disease*.

A word here may be apposite on counsels of perfection and the necessity of the employer doing everything. When you cannot bring any influence to bear external to the workman to remove the *causa causans* and can only then have recourse to remedial measures, you must not fix your standard too high or the result will be either failure altogether, or long delay in getting anything done. The salient feature about skin cancer is that not 5 per cent. begin to show the malady under 30 years of age. The average age among mule spinners who contract the disease is about 52 years. A further point, and this is a still more important point to be borne in mind in considering remedial measures, is that less than 3 per cent. manifest the disease in dangerous form under 20 years duration of employment, while the average duration is approximately 40 years. Periodic examination, therefore, should be limited to mule spinners aged 40 or over and with a duration of employment of 30 years. You will miss a few cases, but the great point is that you will have brought the number to be examined within reasonable limits, you will save expense and prevent evasion of the examination by men who will know that examination for them is a waste of time.

In compensation for deaths alone the cotton industry must anticipate paying £10,000 a year until they realise that by timely periodic examinations twice yearly (which would be enough for all practical purposes) this sum could be considerably reduced and life be spared.

A voluntary examination would be no use in this industry, where there are large numbers to be examined. Even when reduced to the lowest practicable number evasion would be easy, especially from a desire to conceal a condition situated, as it so often is, on the scrotum, with the result that the condition would become inoperable before knowledge of it would be gained. A voluntary examination was tried in South Wales among patent fuel workers over 40 years of age who had worked for more than 10 years. It failed badly in securing attendance, but it may have done good in enabling the workers to know that treatment was available. And treatment of skin cancer never was

so hopeful as it is to-day with radium showing itself as likely to be the remedy par excellence for the condition. A large gas works in London even now sends all its cases of pitch warts (to the number of over 20 every year) to the Radium Institute. The cases are cured by one treatment, and absence from work is limited to a day. There have been no recurrences. I hope the mule spinners, and all coming regularly into contact with tar and pitch, will demand their fair share of the radium which will be distributed to the various hospitals throughout the country before long.

The noticeable increase in the number of cases of chrome ulceration is due to the new process of electrolytic deposition of chrome on metal—chromium plating. Here the hydrogen bubbles, bursting at the surface of the bath, allow a very finely divided spray of chromic acid to escape into the air which is only partially controllable by locally applied exhaust ventilation.

Aniline poisoning, as has been said, is intended to cover poisoning from any nitro and amido derivative which penetrates the skin directly by dissolving out the natural grease and combining with the hæmoglobin to form methæmoglobin. The cases notified are but samples of several others in which the ashen grey colouration of the lips and tips of the ears is present without the worker being aware that anything is peculiar about his complexion. A drop of his blood, however, when the lobe of his ear is pricked with a needle is chocolate coloured. Truly the blood can stand a great deal! Hot summer days prove too much for it, and I have known factories manufacturing these compounds idle because all the men were ill. If work has to be done at all in the summer it must be done before the sun is up or after it is down.

Carbon bisulphide only became notifiable in 1920. It is an interesting instance of a poison the toxicity of which was notorious forty years, and then was satisfactorily dealt with by regulations.

In the early days of vulcanisation of rubber by the "Parkes" or "cold cure" process—dipping the articles into a solution of sulphur chloride dissolved in carbon bisulphide—all those so engaged suffered from its harmful effects; and very serious they were—headache, paralysis, especially of the leg muscles, mental hebetude, impotence, acute mania, and not infrequently amblyopia. Laudenheimer in 1899¹ published the histories of fifty cases of mania in rubber workers. Of the first three cases described in Great Britain by A. Bruce² two suffered from amblyopia. Nettleship³ described a similar case in 1885. So prominent, indeed, did this symptom become that the Ophthalmological

¹ *Die Schwefelkohlenstoffvergiftungen der Gummi-Arbeiter unter besonderer Berücksichtigung der psychischen und nervösen Störungen und der Gewerbehygiene.* Leipzig, 1899.

² "Chronic Poisoning by Carbon Bisulphide," *Trans. Med.-Chir. Soc. Edin.*, 1883-84, pp. 145-153.

³ "A Case of Amblyopia with Partial Optic Atrophy and General Nervous Depression and Emaciation caused by the Vapour of Carbon Bisulphide: Partial Recovery," *Trans. Ophthal. Soc. United Kingdom*, 1885.

Society appointed a committee to investigate the action of the vapour of carbon bisulphide and sulphur chloride on the sight and health. This committee tabulated twenty-four cases, in five of which there was little or no improvement even after giving up the work. Many other references could be given. A story was current in Salford about 1899 of a maniacal rubber worker rushing about the factory brandishing a carving knife. Imagine the effect of this on two hundred factory girls ! The Committee on certain Miscellaneous Dangerous Trades¹ which reported in 1896 recommended special rules, the principal of which were: (1) downward exhaust ventilation, the vapour being more than twice as heavy as air; (2) enclosed machines for waterproofing cloth; (3) no spells of work to last more than two and a half hours without a break of one and a half hours; (4) monthly medical examination of the workers by the certifying surgeon. So successful were the special rules drawn up on these lines that little more was heard of CS₂ until new uses were found for it, and especially in the artificial silk industry by the viscose process. Stress has been laid on the severity of the symptoms in the absence of scrupulous attention to detail in precautionary measures. It is disquieting to hear of a case of amblyopia contracted in an artificial silk factory, and to read, in a recent report of the Chief Inspector of Factories, of a severe case involving "headache, vomiting, delirium, loss of muscular power, and almost complete loss of sensation." The trouble occurs in what is called the "churn" room, where the alkali-cellulose is treated with carbon bisulphide in a hermetically-sealed mixer or churn. After the process is stopped at the desired point a negative pressure is maintained in order to remove the vapour. The workman, however, is then compelled to put his head inside the churn to remove the orange-coloured sticky mass. Few workers in the churn room are free from the slighter symptoms, attributable to carbon bisulphide; nor is this surprising, seeing that 0.3 part per 10,000 of air will produce them. Efforts should be made to find a substitute for carbon bisulphide. This, however, is not the only risk run in the artificial silk industry. Extreme discomfort is caused by the sharp pain, photophobia, and conjunctivitis set up by traces of sulphuretted hydrogen gas generated at the spinning troughs. The gas may not be present in a proportion greater than 1 part in 10,000 of air, but such small amounts are just those to cause the distressing symptoms mentioned. I recall that in the change over from the manufacture of yellow phosphorus to the sesquisulphide a manager of a works confessed that his life was made miserable to him by incessant conjunctivitis until he had placed every bin for the storage of the stuff under a negative pressure. Another manager of a chemical works in those days was visiting weekly (without improvement) an ophthalmic surgeon for chronic conjunctivitis limited to one eye. This eye it was that he applied periodically to the peep-hole of a vat, otherwise closed in, in which H₂S gas was given off. The artificial

¹ C. 8149.

silk industry starts with a tremendous advantage in the experience already gained as to the effects of the toxic agents used or evolved. The day in, day out exposure to them by the workpeople should never be forgotten.

Of chronic benzol poisoning only one solitary case has been notified. The statutory requirement, however, was asked for because of deaths among men engaged in the waterproofing of fabric with rubber dissolved, not in naphtha, the usual solvent, but in benzol, because naphtha was required for other purposes during the war. And they had died after having inhaled the very diluted vapour given off after about three months' exposure with a remarkable train of symptoms due to the destruction principally of the white blood cells, and, to some extent also, of the red. Now that attention has been called to the risk there will be trouble if benzol continues to be used instead of less harmful substances, such as toluol and xylol, as a solvent or thinner for cellulose sprays in motor car and other painting. All good cellulose spray manufacturers should on principle reject benzol as an ingredient.

NOTES ON BOOKS.

THE ARTS AND CRAFTS YEAR BOOK AND DIRECTORY, 1929. London: Hutchinson. 12s. 6d.

Union is strength: one feels that even a book which brings together the names and descriptions of artists, craftsmen and their works is an accession of useful force. Creative people are difficult to organise, but the difficulty must be overcome; they themselves are not averse from an improvement in their lot.

In their long struggle against a complacent philistinism the arts and crafts in England have gained more ground than may be commonly recognised. Their ever firmer alliance with industry is having important consequences. Goodness knows how much industry needed their saving inspiration—needed and *needs*, one should say. And artists generally are still in want of some of that prestige which enables factory hands to claim a minimum of security as essential for adequate production. No-one to-day believes that starvation and overwork are the right conditions for industrial workers; it is even beginning to be felt that they may be the wrong conditions for artists and craftsmen. The sooner these are recognised as having their niche in industry the more quickly will they be enjoying three meals a day.

To the all-important, strategic, central position of the Royal Society of Arts the editors devote nearly eighty pages of their book.

How the British Institute of Industrial Art is succeeding in its purpose of "raising the standard of design and craftsmanship" was illustrated at the recent British Industries Fair at the White City, where the section organised by the B.I.I.A. stood out so remarkably from the rest of the Exhibition.

Like the B.I.I.A., the Rural Industries Bureau has come into being since the war, and has already proved its worth.

The Arts and Crafts Exhibition Society, founded in 1888, held its last show at Burlington House last autumn. Many of the exhibits were remarkably fine.

About these and other organisations Messrs. Hutchinson's handbook gives much pertinent information. It should find its way on to the shelves of all who have the real interests of British art and industry at heart.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4007.

VOL. LXXVII.

FRIDAY, SEPTEMBER 6th, 1929.

*All communications for the Society should be addressed to the Secretary, John Street,
Adelphi, W C (2.)*

PROCEEDINGS OF THE SOCIETY.

SHAW LECTURES

THIRTY YEARS' EXPERIENCE OF INDUSTRIAL MALADIES.

By SIR THOMAS MORISON LEGGE, C.B.E., M.D.,
late H.M. Senior Medical Inspector of Factories.

II.

LEAD POISONING.

(Delivered February, 1929.)

I have left lead poisoning to the last as being the most important form of industrial poisoning and the one about which there is most to say. The essential points to remember about it are : (1) that industrially the compounds alone are poisonous, the handling of metallic lead and its alloys being harmless in the absence of dust ; (2) that two milligrams, i.e., $1/32$ nd of a grain, absorbed daily, will in time undermine the constitution and set up chronic lead poisoning with changes in the kidneys and arteries which will shorten life ; (3) that it is—again I am referring to industrial lead poisoning in this country—entirely due to inhalation of leady dust or fume and not at all to handling ; (4) that absorption takes place far more generally through the lungs than through the alimentary canal ; and (5) that in its prevention we have had the most brilliant successes from the application of the principle on which I have laid so much stress, namely, an influence brought to bear external to the workman over which he can exercise no control, as is patent from the marvellous drop generally, and in white lead works, china and earthenware work and paint and colour works particularly. In contrast, failure and disappointment have resulted where that principle has not been successfully or completely applied, as in lead smelting works, electrical accumulator factories, and in the tragedy of the house-painting industry.

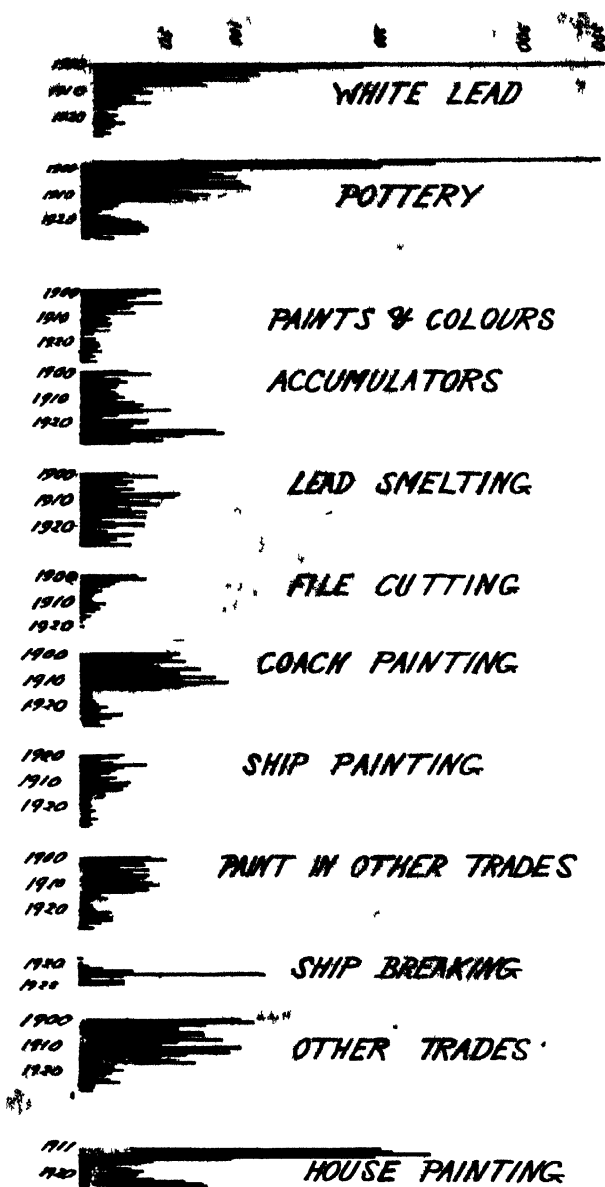


CHART IV

All this and much more is demonstrated in Chart IV, which splits up the great block of lead-poisoning cases shown in Chart I into their main constituent industries on the same scale and over the same number of years. What has brought about the fall in white lead works? The Home Office Regulations (for which I was responsible, I remember, in 1899) are stringent enough as to fan ventilation, stoving, weekly medical examination, and welfare provision. But far more potent than these was the praiseworthy discovery within the trade of the much greater affinity of carbonate of lead for oil than for water. And the great drop is mainly due to the invention of a machine allowing pulp white lead, i.e., a thick suspension of the carbonate in water, to come in at one end to be intimately mixed with oil and to emerge at the other as paint ready for the market.

In pottery manufacture removal of dust by locally-applied exhaust ventilation has accomplished much in the direction of diminution in the poisoning, but the *coup de grace* was delivered by the discovery in the Government Laboratory by its Principal, Sir Edward Thorpe, that, in contrast to raw lead (red lead, white lead) which up to 1890 had been used almost universally for the glaze and is soluble in dilute acids, if the raw lead is mixed with siliceous material this solubility can be greatly reduced. Moreover, the insolubility of the lead depends not upon any one oxide or group of oxides, but on the maintenance of a certain proportion between the whole of the basic oxides on the one hand and the whole of the acidic oxides on the other. It comes to this, then, that you can use as much lead as you did before when using the dangerous raw lead, but if you mix it in certain definite calculated proportions with silica and frit it, it will be comparatively harmless. This is called "low solubility" glaze.

In the manufacture of paints and colours, by which is meant the grinding up of colours into a fine powder under edge runners, with necessarily the production of much dust, the improvement has been mainly due to locally applied exhaust ventilation. Lead smelting, and the manufacture of accumulators, show practically no improvement, and like an honest surgeon, I wish to describe the failures as well as the successes, as from the failures, perhaps, most is to be learnt. Evidently in these industries no method of cutting out the personal element has been made universally applicable. This is true, and the enormous amount of handling and consequent exposure to slight amounts of dust of the lead compounds used are greater almost than can be dealt with by methods of dust removal and welfare unaided. I have introduced the word "almost" into the above sentence because of the meticulous care and attention required (hardly to be expected of human nature in general) of one kind or another, i.e., where the employer does *everything* he can rid himself of the risk.

The actual figures for all the industries (and of others not included) are given in the appendix. The scale is the same as in Chart I. Note that white lead is hoisted up all through a small square too high and that the figures for pottery go back to 1899.

But at what a cost compared to the method of substitution or automatic methods! The accumulator industry is that in which, with the exception of house-painting, at the present time, more cases of poisoning are occurring than in any other. In, perhaps, the largest factory, where everything nearly had been done which human ingenuity could suggest, even to use for a part of the output of pasting machinery, among about 1,000 persons coming into contact with lead compounds 11 cases of lead poisoning occurred in 1926 and 18 in 1927. What more could be done, except to engage a whole-time works surgeon to study the men and the work, to make use of every means at the disposal of science in determining the lead contact of the air in the workrooms, in determining also the day-to-day changes brought about by lead in the red blood cells, and so to find out where the danger was greatest? I leave it to you to say whether it was cause and effect, but this firm had no case in 1928, and none has been reported up to the present (July, 1929). Now that factory I visited thirty years ago on complaint by the District Inspector as to the bad conditions, and it is the only factory in which the escape of dust has been so great as to give me the sweet taste of a salt of lead in my mouth all the time I was there.

The manufacture of electrical accumulators is, I have noticed, more susceptible to anything creating bad conditions than any other. I mean, if manufacture is commenced before the fans, etc., are installed, a crop of cases will occur. If a disturbance in the industry occurs, as it did with the demand for batteries for wireless and for motor cars in 1922-24, there will be a peak. If a machine for the pasting of accumulator plates were made universally applicable, it would halve the number of cases in the industry at once.

The disappearance of lead poisoning in file-cutting, again, is due to the disappearance of the hand-file cutter, the work being done by machinery, largely now on a spelter bed instead of the lead bed which caused all the trouble.

Now while that marvellous drop was going on between 1900 and 1910 in the manipulation of white lead, the number of cases from its use in coach and ship-painting, and in house-painting, was going up noticeably. That arose from the fact that it was impossible to control by a fan, or by any means independent of the workman, the dust generated in rubbing down the painted surface with sandpaper. The fall in incidence of poisoning in coach painting since the war is due to the absence of white lead in the paint, largely owing to the enormous development of spray painting of motor cars, etc. The manufacturers are too sensible, and are too frightened, to think of using lead compounds as an ingredient of cellulose sprays. In house painting, where the rise again after the war is noticeable, the failure of the cases to go on rising to ~~the level they~~ reached before the war is due, in my opinion, to various causes, ~~chief of which~~ are: (1) continued discontinuance of the use of white lead in ~~the internal~~ painting of buildings owing to other paints—those on a

zinc base and titanium oxide giving a much prettier effect ; (2) the fact that the painters who have taken on the work since the war have not accumulated enough lead yet for it to explode as lead poisoning. I do not think it has anything to do with that Act passed in 1927 called the Lead Paints (Protection against Poisoning) Act, which did precisely the opposite of what had been approved in Geneva in 1921 by ninety delegates, representing employers, workpeople and governments from thirty-three countries, none voting against and only one abstaining. Ratification, I hope, will now be made as in the case of the Eight Hours' Day. Why should the house-painters continue to run the risk of poisoning ? Where highly-poisonous ingredients are used in industry, a *laissez faire* policy, is not enough. To ask the house-painter who uses white lead to do no dry rubbing down is to ask him (1) to lose money, as it takes longer and is more trouble to use wet sandpaper ; (2) he must have a pail ; (3) he must have water in it ; (4) he must have sponges ; (5) he must keep his hands wet and so undergo discomfort and run the risk of eczema ; and (6) he must have the will to do all these things. Recently, when staying in France, I experienced unfeigned satisfaction that, at any rate, house-painting had been made safe for the worker there. I was struck, too, by the much more beautiful effects and brighter colours they aimed at and secured in the painting of their buildings with none of the dirty, drab colour, characteristic of white lead after a short exposure to the atmosphere.

Sir Thomas Oliver could not now say, as he did in his Shaw Lecture in 1907, that the French Legislature, despite the agitation in favour of it, always failed to give effect to prohibition.

I have often said that wrong conclusions are sure to be made from statistics of lead poisoning unless you know all about them. For instance, anyone with knowledge could tell at a glance at them that between 1914 and 1919 a cataclysm had occurred to upset them in the way they were upset. And, indeed, you can read the history of the war from the figures. Why should there have been an enormous drop in all the lead industries, except lead smelting and electrical accumulator manufacture ? Because not less lead was smelted, but only that its use was diverted to the making of shrapnel and bullets, and accumulators were in increased demand for motor cars, submarines and wireless. Further, why is the proportion of deaths to cases relatively so much higher in the pottery industry and house painting than in the others ? Is it that they are so much more dangerous ? No ; it is because, once taken up, work in those two industries continues longer than in the others, and the workers become the victims of chronic lead poisoning, so that under the beneficial provisions of the Workmen's Compensation Act, which came into force in 1906, the relatives of a deceased lead worker can justly receive compensation when any sequela of saturnism, such as Bright's disease or cerebral apoplexy, appears on the death certificate.

Further, do the figures help to solve the vexed question, so frequently asked,

Are women more susceptible to lead poisoning than men? Returns of occupiers do not lend themselves readily to a solution of this problem, as no census is given of the number of persons exposed to risk in the different processes. This, however, was done voluntarily over a number of years in the china and earthenware industry, and enabled an attack rate per thousand employed to be made out. Regularly, in the different branches where men and women were employed, the figures showed females to be attacked about twice as frequently as the males. There are many pitfalls, however, as, for example, the possible greater danger in processes in which women predominate or the average shorter duration of their employment. Most cases of lead colic occur within the first two years of employment. Still, I consider women to be more susceptible to effects of lead poisoning than men. The proportion of women notified as suffering from lead poisoning in whom headache is a symptom is more than twice that among the men, and the brain symptoms (encephalopathy, the severest form which lead poisoning can assume) is also greater. On the other hand, paralysis (wrist drop) is more frequent in men, but that is only evidence that their duration of employment is much the longer, as wrist drop is always a late symptom. There is, at all events, no doubt as to the baleful influence of lead compounds on the uterine functions. Disorders of menstruation are common, the tendency to miscarriage in some lead workers is so pronounced that only after ceasing work in lead can full term be reached. When diachylon is taken as an abortifacient the patient usually swims for her life. I mention these facts because a section of well-intentioned persons is bent on an endeavour to remove every restriction on women's work. I personally hold the view that the only restriction which should constitute a bar is employment directly interfering with the function of maternity, and employment in lead is the only one I know. I would prefer to leave it to women to say how far moral dangers should lead to restrictions. Bearing this in mind, a Recommendation of the General Conference of the International Labour Organisation, held at Washington in 1919, urged that "In view of the dangers involved to the function of maternity, and to the physical development of women, and young persons under the age of 18 years, they should be excluded from employment in the following processes.—

- (a) In furnace work in the reduction of zinc or lead ores.
- (b) In the manipulation, treatment, or reduction of ashes containing lead, and in the desilverising of lead.
- (c) In melting lead or old zinc on a large scale.
- (d) In the manufacture of solder or alloys containing more than 10 per cent. of lead.
- (e) In the manufacture of litharge, massicot, red lead, white lead, orange lead, or sulphate, chromate or silicate (frit) of lead.
- (f) In mixing and pasting in the manufacture or repair of electric accumulators."

It was further recommended " That the employment of women and young persons under the age of 18 years in processes involving the use of lead compounds be permitted only subject to the following conditions :—

- (a) Locally applied exhaust ventilation, so as to remove dust and fumes at the point of origin.
- (b) Cleanliness of tools and workrooms.
- (c) Notification to Government authorities of all cases of lead poisoning, and compensation therefor.
- (d) Periodic medical examination of the persons employed in such processes.
- (e) Provision of sufficient and suitable cloakroom, washing, and mess room accommodation, and of special protective clothing.
- (f) Prohibition of bringing food or drink into workrooms."

These points have been embodied in the " Women and Young Persons (Employment in Lead Processes) Act, 1920."

Then a closely allied question is, Does lead poisoning in the father affect his offspring to the same extent as does lead poisoning in the mother? In my view it is all a matter of degree of the poisoning. Under the conditions of its general use in this country now, with the possible exception of house-painters (among whom cases are twice as severe as factory cases and the amount of chronic poisoning four times as great), there is little evidence that a male lead worker is less likely to beget children, or that his children are more likely to be unhealthy than those of men working in any other industrial process. In the absence of any precautions whatever, the effect on the offspring, even in the case of male lead workers, may well be evident, as was shown years ago in the manufacture of pottery as a home industry in Hungary by Chyzer, and again in some other instances cited by Dr. Alice Hamilton in her book, *Industrial Poisons in the United States*. Account has to be taken of so many variables in trying to decide this question as to make a definite conclusion upon it very difficult.

Close analysis made by me of the reports by certifying surgeons on 10,923 cases of lead poisoning notified and reported on during the past thirty years has brought out certain essential facts. Thus, comparison can be made of the cases reported in four five-yearly periods in respect of (1) increase or decrease in the number recorded; (2) severity of attack; (3) number of attack, that is, whether it was the first, second, third or chronic; (4) main symptoms. It brings out also the progress shown in prevention.

Taking the figures as a whole—they are printed in full in Appendix II and some points are shown diagrammatically in Chart V—the most noticeable features are reduction in severity and in the number of chronic cases, and consequential increase in the moderate and slight attacks.

The total number of symptoms greatly exceeds the number of cases, but this does not affect the correctness of the estimate of each one as a proportion

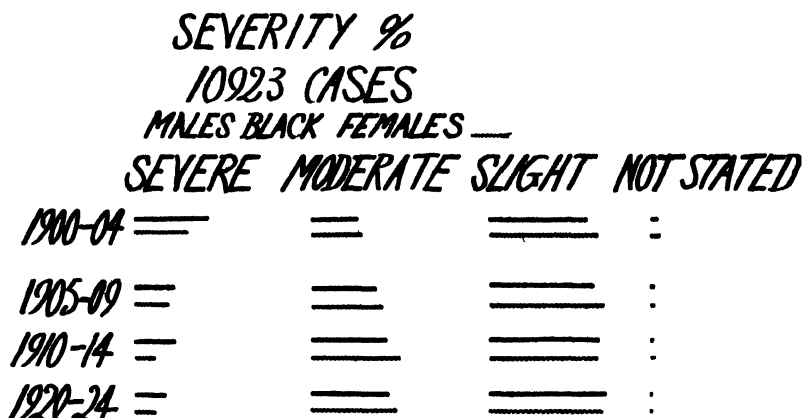


CHART V.

on the total number reported. Nearly always a combination of symptoms—colic, anæmia, headache, etc.—is described as present.

Reduction in the severe cerebral symptoms is very important, as their occurrence must be regarded as due to inhalation of lead dust, or fume, in excessive amount, and indicates failure, therefore, at some point or other in precautionary measures. Happily these cases of encephalopathy have diminished more than any others, as the chart shows. It was the cases of convulsions and blindness in quite young girls, thirty years ago, which agitated so much the public mind.

Discussion has recently been raised over the question—Is there a weakening of the muscles from chronic lead absorption which can serve as a diagnostic

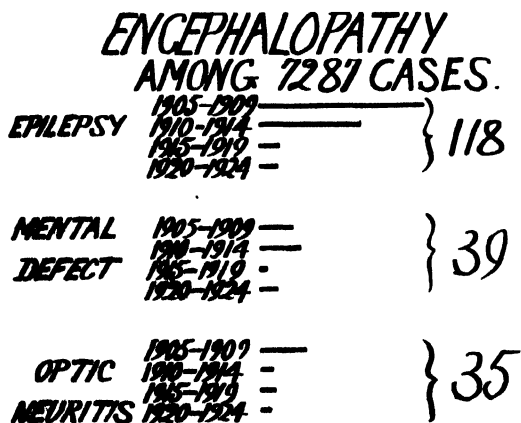


CHART VI.

sign? I believe there is. In this connection it is important to distinguish "weakness" from "palsy," which is a synonym for paralysis. The palsy commonly called "wrist drop," or paralysis of the extensors of the forearm, among house-painters, and other forms of paralysis such as that affecting the small muscles of the hand, where tight gripping of a tool or article has to be practised for hours, day in, day out, as in hand-file cutting and metal capsule polishing, are fairly frequent. But you do not find them, although the same gripping may be necessary in other industries, when no lead is present. So it is not the result of fatigue. The view of the opponents of the idea of "weakness" as a diagnostic sign is that if there is any weakness of the muscles in lead workers it has nothing to do with lead *per se*, but is a consequence of the general weakness of the whole organism and of the whole muscular system. Instruments for testing the muscular power, according as they are manipulated by those who support the contention that "weakness" is a symptom, are usually positive, and by those who deny it, negative.

As bearing on the question whether lead poisoning, apart from paralysis complete or partial, especially of the extensor muscles of the forearm and of the right forearm in preference to the left, also "weakened" them, I analysed 6,499 reports on notified cases by Certifying Surgeons on this point between the years 1910 and 1927. The Surgeons, on the forms they had to fill in, were asked to distinguish between "paralysis" and "weakness." The request was made because there was difficulty in deciding whether such terms as "weakness of arms," "muscular weakness," and "loss of power in the arms," should be interpreted as incipient paralysis or not.

In the 6,499 cases were 680 cases (6.2 per cent.) of paralysis and 603 cases (5.5 per cent.) of weakness. They were distributed as follows:—

Muscles Affected.			Paralysis.		Weakness.	
			Cases	Per cent.	Cases	Per cent.
Arms and legs	Complete	...	11	1.6	88	14.6
	Partial	...	40	5.9		
Legs	Complete	...	4	0.6	52	8.6
	Partial	...	20	2.9		
Both forearms	Complete	...	227	33.4	358	59.4
	Partial	...	175	25.7		
Right forearm	Complete	...	63	9.3	55	9.1
	Partial	...	36	5.3		
Left forearm	Complete	...	27	4.2	35	5.8
	Partial	...	17	2.3		
Fingers	...	...	41	6.0	12	2.0
Other (Deltoid, etc.)	...	...	19	2.8	3	0.5
Total	...	...	680	100	603	100

The point which interests most is the relative degree to which the extensor muscles of the right and left forearm are affected. Not only in regard to paralysis, both complete and partial, is the right forearm shown to be con-

siderably more affected than the left, but it is so also in regard to "weakness." This suggests strongly that there is something more than mere general debility induced by lead which brings this about, and that this something is the action of lead itself, probably on the muscular tissue.

This relationship is shown diagrammatically in the following chart. It also shows what a remarkable feature wrist drop, from the selective toxic action of lead on the musculo-spiral nerve, is.

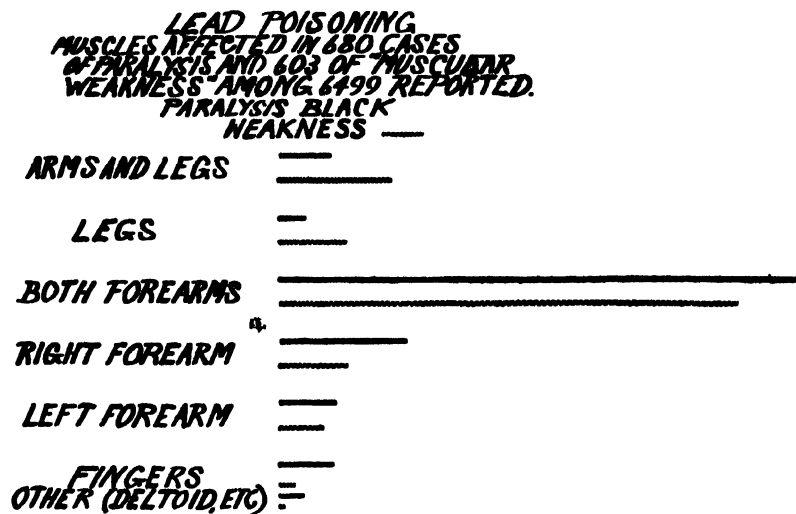


CHART VII.

Indeed, I regard the testing of the strength of grasp and of the strength of the fingers and wrists as the most useful single test there is for detecting chronic lead absorption rapidly, as so often has to be done on factory premises, among a large group of workmen.

In the many doubtful cases of lead poisoning which present themselves, especially of early lead poisoning, a diagnosis must be made from the whole picture and not by a mere adherence to the presence or absence of one or another symptom. The German toxicologists consider the cardinal signs to be blue line, typical facies (cachexia), punctate basophilia in the red blood cells, and the finding of hæmatoporphyrin in the urine. To do this properly, however, requires more complete education of the general medical practitioner in the diagnosis of industrial diseases than he now receives.

Unfortunately, lead poisoning seems to be able to raise its hydra head in all manner of baffling ways. When we imagine we have conquered it, a new form appears which defies our ability to find the needful influence external to the workman, to prevent ill effects. Thus you see from Chart I how cases

in shipbreaking began to appear in 1910, and by 1915, in this quite small occupation, more than a hundred cases were notified. This is due to volatilisation of lead from the paint and red lead backing on the armour-plating by the great heat of an oxy-acetylene blow-pipe flame used for cutting purposes. Experiments carried out under the direction of the Principal Chemist of the Government Laboratory showed that the amount of lead present in 10 cubic metres of air at the breathing level was 49 milligrams, that is, 25 times as great as the daily dose (2 milligrams), which I regard as the minimum which may cause chronic plumbism if inhaled daily. The wearing of a breathing apparatus, i.e., a face-piece with long tubing attached by means of which a person using it breathes ordinary air drawn in through the free end placed several feet distant, is the only complete protection. And what is one to think or say about the great ethyl petrol stunt? That came over from the United States in more senses than one, and to explode it the time and attention of eleven experts was taken up from April 2nd to July 16th, 1928, in coming to the unanimous conclusion "that there were no reasons for prohibiting the use of ethyl petrol." Not a single case of lead poisoning from the use of this substance had or has been reported in this country, but pressure of some sort or other led the House of Lords to move for the appointment of a Committee of Investigation, the same House having shut their eyes to the fact that more cases of lead poisoning were occurring in the house-painting industry than in any other industry.

Lead poisoning can only be prevented; it cannot be cured. Symptoms, though, can be treated and relieved. While saying this I am not unmindful of the undoubted progress that has been made recently in our knowledge of how lead acts when absorbed into the system by Drs. Aub, Fairhall, Minot and Reznikoff, working in the Harvard School of Public Health.* Their view is—and they adduce much in support of it—that lead is probably transported in the blood stream in the form of colloidal lead phosphate, and deposited in the bone tissue as tertiary lead phosphate. This is sensitive to changes in acidity and accounts for the fact that the bulk of the deposited lead is in the bone tissue. They suggest a new line of treatment (for which their book must be consulted) based on the view "that when symptoms of lead intoxication are evident (toxic episodes) it is wise to immobilise lead by impeding its liberation from the bones," and this can best be done by a diet containing much calcium in the form of milk and calcium lactate. Attempt at "deleading" should not be begun until acute symptoms have entirely subsided. To do this either acid should be administered with a diet containing very little calcium, or alkalis should be given alone.

Their experiments prove that lead enters the organism most rapidly by the respiratory tract. Hence the exposure to be most guarded against is inhalation of lead or its compounds in the finely-divided state.

* *Lead Poisoning*. Williams & Wilkins Co., Baltimore, 1926.

APPENDIX* I.
LEAD POISONING.

Industry.	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
1. Smelting of Metals ...	34 ¹	54 ³	28	37 ²	33 ¹	24 ¹	36 ¹	28 ²	70 ²	68 ³	34 ⁵	48 ³	56 ⁷	28 ³	38 ³
2. Plumbing and Soldering ...	9	23	23 ¹	26	21 ²	24 ²	16 ⁴	20 ²	27	28	25 ¹	37 ²	35 ¹	34 ¹	25 ²
3. Shipbreaking ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2
4. Printing ...	18 ²	23 ¹	19	13 ²	15	19 ⁴	16 ²	26 ³	30 ²	21 ¹	33 ⁴	32 ²	37	21 ¹	23 ¹
5. Tinning of Metals ...	5	10	11	14	10	14 ¹	18 ¹	25	10	22	17	13	16 ¹	9	10
6. Other contact with molten lead ...	30 ¹	25	24	23	20	24	24 ¹	19	28	19	17 ¹	37 ⁴	21	28	21 ²
7. White Lead ...	358 ⁵	189 ⁷	143 ¹	109 ²	116 ²	90	108 ⁷	71	79 ²	32 ²	34 ¹	41 ²	23	29 ²	29 ¹
Red Lead ...	19	14	13	6	11	10	6	7	12	10	10	13 ¹	3	7	6
8. Pottery ...	210 ⁸	113 ⁵	88 ⁴	100 ²	109 ⁴	89 ²	112 ⁴	113 ³	119 ¹²	59 ⁵	78 ¹¹	93 ⁴	81 ¹⁵	63 ¹¹	28 ⁶
9. Vitreous Enamelling ...	11	9	3 ¹	4	3	2	4	6	7	7	17	19 ¹	5	9	11
10. Electric Accumulators ...	33	49 ¹	16 ¹	28	33	27 ¹	26	21	25 ¹	27 ²	31	24 ¹	38 ¹	44	41
11. Paints and Colours ...	56 ¹	56	46	39 ¹	32 ¹	57 ¹	37	35 ¹	25	39 ²	17 ¹	21	19	22 ¹	21
12. Indiarubber ...	1	1	2	1	1	4	2	1	2	4	3	8	4	2	9
13. Coach Building ...	70 ⁵	65 ⁴	63 ¹	74 ⁵	49 ⁴	56 ²	85 ⁷	70 ²	70 ²	95 ⁶	70 ⁵	104 ⁵	84 ⁷	71 ²	57 ¹
14. Shipbuilding ...	32 ²	28 ¹	15 ¹	24 ¹	48	32 ²	26 ¹	22 ¹	15	27 ¹	21 ²	36 ⁶	34 ⁵	31 ¹	31 ¹
15. Paints used in other Industries ...	60 ⁵	61	44 ¹	46 ¹	27 ²	49 ²	37 ²	49 ²	47 ¹	42	51 ²	56 ¹	48 ²	49 ²	39
16. Other Industries... ..	122 ⁷	143 ¹²	90 ²	70 ²	69 ⁵	71 ²	77 ²	65 ²	80 ⁶	55 ⁴	47 ²	87 ²	84 ²	90 ²	56 ¹
TOTAL ...	1058 ¹⁸	863 ³⁴	629 ¹⁴	614 ¹⁹	597 ¹⁶	592 ²²	632 ²³	578 ¹⁶	646 ²²	553 ²⁰	505 ²²	660 ²⁷	587 ⁴⁴	535 ²⁷	445 ²²
House Painters ...	119 ¹²	169 ⁴¹	179 ²²	201 ²⁰	227 ²⁸	163 ¹⁶	181 ²⁶	174 ²⁸	239 ⁴⁴	241 ⁴⁷	232 ²⁷	212 ²⁶	217 ²⁷	249 ²¹	207 ²²
House Plumbers ...	...	...	...	...	...	...	...	...	...	...	...	51 ¹²	39 ¹⁰	43 ⁶	34 ⁴

* The raised figures refer to deaths.

Industry.	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
1. Smelting of Metals	...	47 ¹	39 ⁴	46 ¹	15 ¹	24 ⁵	45 ³	25 ⁴	9 ²	38 ¹	22	26 ¹	21 ¹	36 ²
2. Plumbing and Soldering	...	17 ²	12	34	21 ²	9	3 ¹	7	8	6	7	7 ²	11 ¹	11 ¹
3. Shipbreaking	...	...	...	...	3	1	3	7	17	38	31	8	32	32
4. Printing	...	27 ²	12	6 ³	8 ¹	10 ¹	9	12 ¹	11	6 ¹	8	8	10	3
5. Tinning of Metals	...	3	4	2	2	2	2	1	2	3	4	2	3	1 ¹
6. Other contact with molten lead	...	16	29 ¹	27	7	9 ¹	13 ²	7 ¹	15	23 ¹	17 ¹	16 ⁴	17	9 ¹
7. White Lead	...	40	18 ¹	17	—	10	17	13 ¹	15 ²	22	15	8 ¹	12	7 ¹
8. Pottery	...	8	15	13	2	15	11	4	7	15	7	5	9 ¹	2
9. Vitreous Enamelling	...	26 ⁴	23 ⁷	15 ⁷	11 ¹	21 ²	35 ¹¹	42 ¹⁷	44 ¹¹	47 ¹⁸	47 ⁵	41 ¹⁴	14 ⁵	23 ¹⁰
10. Electric Accumulators	...	5 ¹	5	1	—	1	2	8	3	9	9 ²	8	12	23
11. Paints and Colours	...	64	44 ¹	27 ¹	16	48 ²	47 ²	35	32	96 ²	101	52	58	33 ¹
12. India-rubber	...	12	22	10	3	11	9	13 ¹	14 ¹	11 ¹	8	10	6	12 ¹
13. Coach Building	...	8	9	8	7	5	7	4 ¹	3	5	3	2	2	1
14. Shipbuilding	...	39 ⁵	33	21 ²	12 ²	11 ²	13	20 ¹	15 ¹	13 ³	30 ⁴	14 ²	14 ²	18 ²
15. Paints used in other Industries	...	18 ²	25 ³	19	9 ²	8 ²	9	12 ¹	8 ¹	8 ¹	13	8	10 ¹	7 ²
16. Other Industries...	...	35 ¹	38 ⁴	51 ⁶	13 ¹	13 ¹	18 ¹	23 ¹	19	22 ²	26 ¹	11	11 ¹	10
TOTAL	...	381 ²¹	348 ²¹	317 ²¹	144 ¹¹	207 ²²	243 ²²	230 ²³	247 ²⁶	486 ³²	326 ¹³	242 ²⁸	249 ¹⁴	239 ²²
House Painters	...	108 ²⁸	52 ¹⁵	43 ¹³	25 ¹³	37 ¹⁶	46 ²¹	42 ¹⁵	40 ¹²	53 ¹⁷	88 ⁹	90 ¹⁸	98 ²¹	87 ¹⁰
House Plumbers	...	23 ⁸	20 ⁵	14 ⁵	10 ⁷	3 ¹	10 ⁴	8 ⁴	16 ⁵	17 ⁷	13 ¹	16 ⁵	12 ²	18 ⁴

LEAD POISONING*

Year.	Phosphorus Poisoning.	Mercurial Poisoning.	Arsenical Poisoning.	Toxic Jaundice.	Anilin Poisoning.	C82 Poisoning.	Chronic Benzene Poisoning.
1900	3	9	22 ^a	—	—	—	—
1901	4	18	12 ¹	—	—	—	—
1902	1 ^a	8	5	—	—	—	—
1903	—	8	5	—	—	—	—
1904	1 ¹	3	5	—	—	—	—
1905	3 ¹	8	1	—	—	—	—
1906	—	4	5	—	—	—	—
1907	1 ¹	7	9 ^a	—	—	—	—
1908	1	10	23 ¹	—	—	—	—
1909	3	9	4	—	—	—	—
1910	—	10 ¹	7	—	—	—	—
1911	—	12	10 ¹	—	—	—	—
1912	—	17	5	—	—	—	—
1913	—	14	6	—	—	—	—
1914	—	10	2 ¹	—	—	—	—
1915	3	6	3	—	—	—	—
1916	2	17	—	206 ⁵⁷	—	—	—
1917	3	19	30 ⁵	190 ⁴⁴	—	—	—
1918	3	9	3 ¹	34 ¹⁰	—	—	—
1919	1	7	4	3 ^a	—	—	—
1920	—	5	3	6 ^a	—	—	—
1921	—	—	1	1 ¹	—	—	—
1922	—	6	—	3	—	—	—
1923	—	4	—	7 ^a	—	—	—
1924	—	5	6 ¹	3	—	—	—
1925	—	5	6	2 ¹	31 ¹	3	—
1926	—	4 ¹	5 ^a	2	33 ¹	1	1
1927	—	3 ^a	3 ¹	3	38 ¹	—	—
1928	—	4	2 ¹	6	41	1	—

EPITHELIOMATOUS ULCERATION.

Year.	Pitch.	Tar.	Paraffin.	Oil.	Total.
1920 ...	32	10 ¹	3	—	45 ¹
1921 ...	24 ^a	8	—	—	32 ^a
1922 ...	23 ¹	4 ¹	5 ¹	—	32 ^a
1923 ...	25 ^a	11 ¹	6	16 ¹	58 ^a
1924 ...	23 ¹	8 ^a	2 ¹	90 ¹⁰	123 ^a
1925 ...	35 ^a	28 ^a	4	93 ⁴⁴	160 ⁵⁵
1926 ...	49	27 ¹⁴	2	109 ³⁵	187 ⁴⁹
1927 ...	34 ¹	24 ^a	6	110 ⁴⁰	174 ⁴⁹
1928 ...	32	36 ¹⁰	2 ¹	105 ³⁹	175 ⁵⁹

CHROME ULCERATION.

Year.	Bichromate Manfc.	Dyeing & Finishing.	Chrome Tanning.	Other.	Total.
1920 ...	77	43	4	2	126
1921 ...	13	14	2	—	29
1922 ...	10	26	1	5	42
1923 ...	7	35	3	13	58
1924 ...	11	18	6	10	45
1925 ...	5	32	8	9	54
1926 ...	2	33	2	18	55
1927 ...	12	25	7	21	65
1928 ...	3	28	4	35	70

* The raised figures refer to deaths.

ANTHRAX.

Year.	Wool.	Horsehair.	Hides and Skins.	Other Industries.	Total.
1900	10 ^a	12 ^a	9 ^a	6 ^a	37 ⁷
1901	8 ^b	9 ^a	20 ^a	3	40 ¹¹
1902	13 ^a	10 ^a	11 ^a	4	38 ⁹
1903	26 ⁷	7 ^a	12 ^a	3 ^a	48 ¹³
1904	16 ^a	12 ^a	18 ^a	4 ^a	50 ¹⁰
1905	35 ¹³	7 ^a	17 ^a	1 ^a	60 ¹⁹
1906	30 ⁹	10 ^a	19 ⁷	10 ³	69 ²²
1907	24 ^a	17 ^a	12 ^a	5 ^a	58 ¹¹
1908	19 ^a	10	13 ^a	5 ^a	47 ⁷
1909	29 ^a	8 ^a	18 ^a	1 ^a	56 ¹³
1910	28 ^a	6 ^a	14 ^a	3 ^a	51 ⁹
1911	35 ¹⁰	8 ^a	20	1	64 ¹¹
1912	31 ^a	7	8	1	47 ^a
1913	43 ^a	5 ^a	19 ^a	3	70 ^a
1914	29 ^a	5	15 ^a	6 ^a	55 ⁷
1915	26 ^a	2	18 ^a	3 ^a	49 ^a
1916	80 ¹²	6 ^a	18 ^a	2	106 ¹⁸
1917	65 ¹¹	1	29 ^a	4 ^a	99 ¹⁴
1918	49 ^a	4 ^a	14 ^a	1	68 ⁷
1919	34 ^a	3 ^a	16 ^a	4 ^a	57 ⁹
1920	25 ⁷	5 ^a	17 ^a	1	48 ¹¹
1921	11 ^a	4 ^a	8 ^a	2 ^a	25 ^a
1922	19 ^a	9 ^a	16 ^a	1	45 ^a
1923	14 ^a	9 ^a	22 ^a	1 ^a	46 ⁵
1924	19 ^a	4 ^a	16 ^a	4	43 ^a
1925	25 ^a	3 ^a	16 ^a	1	45 ⁹
1926	15 ^a	8 ^a	12	3	38 ^a
1927	18 ^a	3 ^a	9	1	31 ^a
1928	14 ^a	4 ^a	24 ^a	3 ^a	45 ^a

APPENDIX II.

ANALYSIS OF REPORTS ON 10,923 CASES OF LEAD POISONING.

I analysed 10,923 cases of lead poisoning notified and reported under section 73 of the Factory and Workshop Act, 1901, according to: (1) the severity of the attack; (2) the number of the attacks; and (3) the main symptoms in four quinquennial periods as set out below. The reports were those made by Certifying Factory Surgeons.

In general, "Severe" includes: (a) Paralysis; (b) encephalopathic conditions—convulsions and mental affections; and (c) grave undermining of the constitution associated with Bright's disease and arterio-sclerosis. "Moderate" includes: (a) a combination of colic with anæmia; (b) profound anæmia; (c) partial paralysis; and (d) cases in which there is constitutional debility. "Slight" includes: (a) colic, constipation and rheumatic pains; (b) anæmia; and (c) either of the above with muscular weakness.

Number of attacks has reference to definite occurrence of disability. Cases appearing under 3rd or chronic would generally have appeared also under "Severe" attacks.

The total number of symptoms greatly exceeds the number of cases, but this does not affect the correctness of the estimate of each one as a proportion

on the total number reported. Nearly always a combination of symptoms—colic, anæmia, headache, etc.—is described as present.

The Tables show a noticeable decline in the severity of the cases in the last quinquennial period as compared with the first two.

Cases showing encephalopathic symptoms are very distinctly fewer, and cases of paralysis fewer than they used to be, although it should be remembered that the separation of "weakness of the arms" as an entry was included under "paralysis" until 1909 and therefore swells the figures under that heading.

Paralysis appears to be commoner in men than in women; headache and encephalopathy, on the other hand, commoner in women than in men.

NUMBER OF ATTACKS.

		1st.		2nd.		3rd or chronic.		Not stated		Total.	
		M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1900-04	Cases ..	2,019	419	462	87	460	26	131	32	3,071	564
	Per cent. . .	65.7	74.3	15.0	15.4	15.0	4.6	4.3	5.7	100	100
1905-09	Cases ..	1,781	380	409	32	298	20	77	5	2,566	
	Per cent. . .	69.4	86.9	15.9	7.3	11.6	4.6	3.0	1.1	100	100
1910-14	Cases ..	1,863	260	305	17	251	8	32	6	2,455	291
	Per cent. . .	76.0	89.4	12.5	5.8	10.2	2.7	1.3	2.1	100	100
1920-24	Cases ..	1,117	114	98	5	181	22	5	1	1,401	142
	Per cent. . .	79.7	80.3	7.0	3.5	12.9	15.5	0.4	0.7	100	100

SEVERITY OF ATTACK.

Year.		Severe.		Moderate.		Slight.		Not stated.		Total.	
		M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1900-04	Cases ...	1,020	137	640	128	1,324	273	88	26	3,072	564
	Per cent. . .	33.2	24.3	20.8	22.7	43.1	48.4	2.8	4.6	100	100
1905-09	Cases ...	568	67	749	141	1,198	223	50	6	2,565	437
	Per cent. . .	22.1	15.3	29.2	32.3	46.7	51.0	1.9	1.4	100	100
1910-14	Cases ...	450	27	790	117	1,184	141	27	6	2,451	291
	Per cent. . .	18.4	9.3	32.2	40.2	48.2	48.5	1.1	2.1	100	100
1920-24	Cases ...	201	14	460	55	736	72	4	1	1,401	142
	Per cent. . .	14.3	9.9	32.8	36.7	52.5	50.7	0.3	0.7	100	100

MAIN SYMPTOM.

Year.		Gastric.		Anæmia.		Head-ache.		Parietic.		Encephalopathy.		Rheumatic.		Other.	
		M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1900-04	Cases ..	2,521	431	619	132	278	120	577	68	113	45	289	64	47	5
	Per cent.	82.1	76.4	20.2	23.4	9.0	21.3	18.8	12.0	3.7	8.0	9.4	11.3	1.5	0.9
1905-09	Cases ..	1,991	348	854	193	261	135	613	85	87	17	279	43	129	11
	Per cent.	77.6	79.6	33.3	44.2	10.2	30.9	23.9	19.5	3.4	3.9	10.9	9.8	5.0	2.5
1910-14	Cases ..	1,853	225	825	112	303	81	333	15	53	10	293	28	186	12
	Per cent.	75.7	77.3	33.7	30.5	12.4	27.0	13.6	5.2	2.6	3.4	12.0	9.6	7.6	4.1
1920-24	Cases ..	1,133	102	519	69	130	33	99	7	15	3	97	15	146	22
	Per cent.	80.9	71.8	37.0	48.6	9.3	23.2	7.1	5.0	1.1	2.1	6.9	10.6	10.4	15.5

THE GARDEN TULIP.*

By SIR DANIEL HALL, K.C.B., D.Sc., LL.D., F.R.S., M.R.I.

The tulip is not an English or even a European flower. In Europe there is possibly one wild species, *T. australis*, the nodding headed yellow "tulip of Bologna" of the early herbalists, which is possibly wild in the Apennines, in Sicily, in the Cevennes and some localities in Spain and Portugal. But the species which is sometimes credited with being wild in England, *T. silvestris*, is undoubtedly a garden stray, which both here and on the Continent is only found on land that has at some time been cultivated. The garden tulip first became known to Western Europe through Busbequius, an ambassador of the Emperor to the Sultan, who met with them on his way to Constantinople in 1554. Busbequius sent home bulbs and seeds; there were other sources of importation, and the first record we have is that Gesner saw one blooming in 1559 in the garden of Councillor Herwart in Augsburg. As a flower it leapt into instant fame, and as it was a time of great activity in gardening, by the close of the century, the tulip was widely distributed in Vienna and Germany, in Holland and Flanders, in England, France and Northern Italy.

But the tulip when it arrived from the East was already a made flower—that is, it possessed a number of varieties which, however, in the general run of their characteristics do not differ at all from those we grow to-day. The original tulip had narrow petals which came to a point—many of the existing garden tulips still have that character—but the Western gardeners have selected by preference tulips with short rounded broad petals forming a cup. It is still unknown how this Eastern garden tulip arose. None of the species that have since been discovered in Western or Central Asia, the real home of the genus, can be appealed to with confidence as the source of the garden tulip. Nearly all the varieties of the garden tulip are fertile with one another, which is some argument against a hybrid origin. Again, among the garden tulips are both white and yellow grounds, yet no species akin to the

*Abstract of a paper read before the Royal Institution of Great Britain on May 3rd, 1929.

garden tulip possesses a white ground. One might still suppose that the white ground had arisen in cultivation as a "mutation," were it not for the fact that the white ground behaves as a simple "dominant" to the "recessive" yellow ground, and dominant mutations are very rare. For the present we can do little more than speculate about the origin of the garden tulip; we shall probably get some light from breeding experiments with tulip species, but these are slow, because it takes six years before a tulip-seed reaches the flowering stage. The origin is certainly remote in time; the locality, probably Persia. All the Eastern peoples call the tulip by its Persian name, *lalé*. Our name tulip is equivalent to turban, and is due to a misapprehension on the part of Busbequius, who probably thought his interpreter was giving him the name of the flower when he was really comparing it to a fez. From its earliest arrival in Europe the garden tulip showed one peculiarity exhibited by no other flower. The seedlings are self-coloured when they first bloom, pink, crimson, or purple, or brown, orange or scarlet. Suddenly, in any year, some of them may become variegated, and show crimson or purple streaks upon a white ground, or brown streaks upon a yellow ground. This change is called "breaking," and is permanent in the sense that the offsets from the bulb that broke are also broken. Yet it is not reproduced in the seed from the broken bulbs, and is, therefore, not a case of "sporting" in the usual horticultural sense of the word. The broken tulips are always a little smaller and the plants less vigorous and less productive than the breeders from which they originate. The variegation is to be seen in the leaves as well as in the flower. The broken flowers have always been most prized by the fanciers; formerly the early unvariegated forms were only kept as stepping-stones to the broken varieties, and were known as "breeders." Nowadays it is the breeders that are chiefly grown for decorative purposes.

Breaking remained unexplained until recently, when certain analogies led to the suggestion that it might be due to a "virus," one of the ultra-microscopic filter-passing agents such as cause mosaics and variegation in Abutilon, Potato, and Tomato. Last year Miss D. M. Cayley at the John Innes Horticultural Institution succeeded in grafting unbroken tulips on broken ones, whereby they were induced to break to the extent of over thirty per cent. in the first season. Similarly introducing plugs of broken tissue into unbroken bulbs induced breaking, so that the evidence is strongly in favour of breaking being induced by the transmission of a virus. The question is then of the agent effecting the transmission in nature. With many plants some species of aphid carries the virus, and at least four species of aphid are found on the tulip at some stage or other. A year or two back Dr. E. J. Collins, of the John Innes Institution, got evidence in favour of transmission by aphid, but not conclusive, because the controls were not free from infection. More extensive trials are being conducted by Mr. McKenny Hughes with each of the four species of aphid, in one case with a positive result as far as one season's test can be trusted. It is, perhaps, significant that the aphid inculcated, *Myzus persicae*, is the chief transmitter of potato mosaic. While the story is still incomplete, the hypothesis that breaking is due to a transmissible virus is at least reasonably probable. The old florists were always looking for methods that would make tulips break, and now we should be able to do it with some certainty. But the modern commercial tulip-grower is anxious to keep his tulips from breaking, because there is little or no demand for the breaks that come from the favourite market and decorative varieties. If we can fix the transmission of the virus upon a particular aphid it will be easy to find a method of keeping the tulip-beds free of that carrier.

There are several other strange "sports" among tulips. For example "parrot tulips," with the petals cut and laciniated, and splashed with body-colour and even

with green, have been known since 1665. Most of the parrot tulips are yellow-ground varieties of unknown origin, but of recent years one or two with white grounds have arisen among known varieties as "sports." Whether they breed as such has never been ascertained. It seems a good working hypothesis to suppose that "parrotting" is also due to a virus or a combination of viruses, and Miss Cayley has started up experiments to test this idea. Sports of a normal type are not unknown among tulips, generally a colour-change, as, for example, to a deeper shade of pink. Sometimes the ground-colour changes, and a tulip that is flushed with pink on a white ground throws a sport flushed with orange on a yellow ground. It is noteworthy that the only changes of this kind recorded are from the white to a yellow ground, from the dominant to the recessive, as though the change came about by loss.

One kind of sport, however, remains inexplicable the occurrence of "thieves." A thief is a sport which has been known to occur in many varied stocks of tulips, and the odd thing is that the thief is much the same sort of tulip, whatever the variety from which it has been originated. It is a narrow-petalled, weak-looking flower, flushed with pink on a ground often tinged with yellow, so characteristic that in the past it was even endowed with specific rank as *T. platystigma*. Though thieves have been known for a long time, it has only recently been made certain that they represent definite changes in a variety, and are not rogues due to accidental mixture of another stock. Till they have been investigated by breeding experiments it is almost useless to speculate on their nature.

Last autumn various tulip bulbs just starting into activity were exposed to X-rays (90,000 volts) for half-an-hour. They are now flowering, and in all cases the flowers have narrow pointed petals; the foliage is also drawn up and pointed. The anthers and pollen appear unchanged; the ovaries have been destroyed. Whether this curious change is permanent, and what other changes in the plant accompany it, has yet to be ascertained. It will be evident that much research is called for, and will inevitably be a lengthy affair, since each generation will require at least six years to reach the flowering stage.

TRADE IN THE HWAI RIVER BASIN (CHINA).

The Hwai River is one of the many little-known rivers of China of much importance in the distribution of trade, writes, the United States Consul at Nanking. It rises in the south-eastern corner of Honan Province and flows eastward through the Province of Anhwei into Hungtze Lake, whence its waters find egress through the Grand Canal to the mighty Yangtze. The Hwai and its tributaries, in conjunction with the Tientsin-Pukow Railway and the Grand Canal, form a natural system for the assembly and distribution of merchandise throughout all north central Anhwei, serving with remarkable facility and completeness the traffic needs of one of the most thickly populated regions of China.

Many centuries ago the Hwai discharged its waters into the Yellow Sea near Haichow, in Kiangsu Province, while the Yellow River, "the scourge of China," discharged into the sea near Tientsin; but about the thirteenth century calamitous floods broke into the dykes of the Yellow River and pushed its entire volume across country and into the channel of the Hwai. After their union the greater river forced the lesser from its bed and the waters of the latter sought a new outlet across the low-lying lands west of the Grand Canal to the River Yangtze.

For the past three-quarters of a century the constant menace to the entire Hwai River Basin from frequently recurring floods has occasioned many plans

for dyking and drainage of the river and for the maintenance and improvement of the Grand Canal. In 1914 engineers who were sent out by the American Red Cross made a thorough investigation of flood-prevention possibilities, and six years later a distinguished American engineer presented to the Chinese Government an exhaustive plan for draining the Hwai River Basin into the sea at a cost of less than \$6,000,000 in gold, as compared with previous plans for an estimated cost of \$90,000,000.

The Hwai Basin embraces approximately 21,600 square miles of an exceedingly fertile and productive country. Over 90 per cent. of the population is made up of farmers, and the principal crops grown are wheat, soy beans, sesamum, kafir corn, maize, China jute, tea, and rice, and approximately 60 per cent. of the farms are double-cropped. Of those crops which furnish an exportable surplus and whose yields serve as indexes of the purchasing potentialities of the people, wheat constitutes, roughly, 50 per cent. and soy beans 30 per cent.

Pengpu, the most important trade centre of the region, is situated at the intersection of the Tientsin-Pukow Railway and the Hwai River, 109 miles by rail from Pukow. All the produce of the region is gathered here and carried by rail to Shanghai, while imported goods come up from the coast ports by rail to Pengpu and are thence distributed by junk service on the Hwai or its tributaries throughout the interior.

The greater part of the trade of the Hwai River district is in the form of indirect barter, mainly owing to the absence of modern banks in nearly all the interior cities and towns, and because most of the Chinese firms bringing foreign goods into the Hwai River Valley pay for them by sending out local agricultural produce.

When imported goods are sent up country, the consignee is debited with the amount of their cost, and when beans, wheat, hemp, or other products of the interior are sent down, the amounts realised from them are placed to his credit. Where currency is used, the general media of exchange are the Chinese silver dollar and the fractional silver 25-cent and copper 1-cent pieces, whose exchange rates are subjected to constant and wide fluctuations. In the district served by the Pi River, a tributary of the Hwai, there are practically no Chinese silver dollars, their place being taken by Spanish dollars, whose mint dates vary from 1773 to 1810. It is one of the curiosities of trade that these old Spanish dollars circulate at a premium.

A considerable variety of foreign manufactures is now sold in the Hwai River Valley. The more important lines are cigarettes, kerosene oil, sugar, indigo, cotton goods, soda, paper and matches, but less important commodities which also find a good sale are wire, nails, galvanized-iron sheets, lamps and lanterns. Imports emanating from the United Kingdom are soda, sugar, cigarettes, cotton goods, and kerosene oil. Germany has a share in the indigo market and in various lines of cheap hardware, while Japan supplies cheap hardware, enamel and aluminium ware, cotton goods and sugar.

Every district of China has evolved a special type of watercraft to meet the requirements of its streams, and along the Hwai and its tributaries are found junks and sampans of a surprising diversity of construction, each devised for some special purpose. In the smaller streams, such as the Pi, during the dry seasons the water is so low and rapids so frequent that even junks of the shallowest draft cannot operate. Here the ingenious Chinese boatman has evolved a unique type of raft-boat, made by fastening bamboos together so as to form a platform capable of supporting no small amount of cargo, but which will float in no more than a few inches of water. The forward ends of the bamboos are bent upward, to prevent the rafts catching on rocks or other obstacles as they glide over the shallow waters.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4008.

VOL. LXXVII.

FRIDAY, SEPTEMBER 13th, 1929.

*All communications for the Society should be addressed to the Secretary, John Street
Adelphi, W.C.(2.)*

NOTICE.

CHANGE OF TELEPHONE NUMBERS.

The Society's Telephone Numbers have been changed and are now.—
General Number, Temple Bar 5610.
Examinations Number, Temple Bar 2785.

PROCEEDINGS OF THE SOCIETY

SHAW LECTURE.

THIRTY YEARS' EXPERIENCE OF INDUSTRIAL MALADIES.

By SIR THOMAS MORISON LEGGE, C.B.E., M.D.,
late H.M. Senior Medical Inspector of Factories.

III

COMPENSATION FOR INDUSTRIAL DISEASES.

(Delivered March 4th, 1929.)

In the last course of Shaw lectures given here in 1907 Sir Herbert Samuel, as Chairman, made some remarks which might fittingly introduce my lecture to-night on "Twenty Years of Compensation for Industrial Diseases." He came fresh from having steered successfully through Parliament the "Workmen's Compensation Act, 1906", which, for the first time, brought industrial diseases under the Act for purposes of compensation on the same line as accidents. "One might look forward," he said, "to the time when the principle would become recognised that there should be no such thing as industrial disease possible. They might be far away from that day, but he thought

that was the goal. . . . It was the duty of scientists to discover the remedies for preventing industrial diseases, and he held it was one of the prime duties of the State as soon as the remedy was found to require that it should be adopted."

In the controversies which have centred round the modern factory system the student can readily distinguish three periods in which a fresh distinct appeal was made to the mind of the thinking public on the score of health. The first period was much the longest, extending over about half a century, from before 1800 to 1850, and the controversies waged during it were excited by concern at the excessively long hours worked by children and the extreme instances of fatigue among them. Inquiry into these long hours disclosed well nigh unbelievable facts which are to be read in the evidence taken before the Royal Commission appointed in 1833.

In the controversies over this period the names of Dr. Thomas Perceval, of Manchester, Owen, Oastler, Sadler, Shaftesbury and Thackeray, are household words. As a result of outside pressure from men such as these, before 1850 the hours were limited to ten a day, and of children under 11 to the same hours on alternate days, or half time, with compulsory school attendance.

The second period extended from 1850 to about 1890 and was mainly taken up with concern over the toll taken in life, and danger to limb from accidents from machinery, and with legislation for preventing them by guarding. From about 1870 onwards, industrial diseases became more and more prominent. Notable features of the factory legislation between 1878 and 1895 were the provisions made to control dangerous trades by means of special rules and to obtain early knowledge of certain occupational diseases by placing the obligation to notify them on the medical practitioner and the occupier. Finally, under the Workmen's Compensation Act, 1906, twenty-five occupational diseases were scheduled to which the Act, with differences depending on the essential distinction between accident and disease, applies and to this list others have been added from time to time since, and to-night I deal with a few of them.

In the last two lectures I laid stress on the fact that samples of the eleven notifiable diseases which medical practitioners are called upon to report suffice, the object being to afford a clue to the factory inspector of conditions over which he can exercise control.

The objects of the Workmen's Compensation Act and of the Factory Act are not the same. The Compensation Act is wider, as it is intended to cover *all* cases of sickness of strictly occupational origin. The individual is here concerned, and not merely the conditions under which he works. Any description of disease, therefore, for which compensation can be claimed must be worded very widely, so as to sweep into the net all cases and not merely those with marked symptoms. Hence it is that in the description (and a very essential part the description plays) of the diseases scheduled for compensation the broadest possible designation is given, including the sequelæ, and a wide

description also is given of the process or processes in which it is presumed that the worker was engaged when he contracted the malady.

There are now some thirty-three diseases to which the consolidated Act of 1925 applies. A glance at the list reveals the absence of certain forms of poisoning and well-recognised trade diseases which might have been expected to find a place.

TESTS APPLIED TO EACH DISEASE.

For the reasons which dictated the omission of certain diseases we must look to the tests applied to each disease by the Committee on Compensation for Industrial Diseases before the disease in question was held to come within the scope of the provisions and intentions of the Act. They were :

1. Is it outside the category of accident and diseases already covered by the Act ?
2. Does it incapacitate for more than a week ?
3. Is it so specific to the employment that causation by the employment can be established in individual cases ?

You do not find poisoning by sulphuretted hydrogen gas in the list because it was thought then to be invariably sudden and, therefore, in the nature of an accident, so that after-effects can be referred back to the definite time when inhalation occurred. But such acute poisoning is already covered by the Act, and only poisoning which is slow and insidious in onset and which might not easily be referred back is not covered. Poisoning of this slow type may result from nitrous fumes, carbon bisulphide, or from chronic benzol poisoning, and they are all included. In my first lecture I explained why now I think the same view should be taken of the chronic effects of sulphuretted hydrogen gas which are found in the artificial silk industry by the viscose process. Poisoning by carbonic oxide does not find a place because no convincing evidence was presented to the Committee that it should be treated otherwise than as an accident. There would have been danger in scheduling the sequelæ of carbonic oxide poisoning, such as loss of memory and dementia, seeing how widespread is the use of gas in industry, and how easily subjective symptoms from it might be alleged with a view to putting up claims for compensation.

In the very rare instances in which hernia can be ascribed to a sudden strain, it would come within the definition of an accident. The Committee of which I was a member on the evidence heard, could not regard hernia as an industrial disease, nor as an injury, not being an accident due to employment.

The second test excludes a malady like brass-founders' ague, as the attack is transitory and does not last a week nor the three days to which the waiting time for the award of compensation has been reduced. Similarly, boiler-makers' deafness, very, very trying condition as it is, causes no absence from work.

The third test probably excludes the largest number of industrial maladies, namely, those such as bronchitis due to the inhalation of dust because the

symptoms are not sufficiently distinctive to enable one to say whether dust or chill was the cause. The one disease which the Committee considered to be a sufficiently distinguishable trade disease, but nevertheless decided, at any rate for the time being, not to recommend its inclusion, was silicosis. They felt this course was best in the interests of the workmen themselves, because in no other of the diseases considered was there so long a preliminary period during which there are equivocal symptoms—cough and the like—which may or may not become graver and ultimately declare themselves as the disease for which compensation is payable. Every case of cough in a stone-masop, for example, might arouse suspicion that it was a symptom of the incurable disease, involving payment of a large sum in compensation, and unemployment among persons so suffering would, it was feared, inevitably result, because employers might dismiss them before incapacity had arrived. It is not loss of employment but incapacity which entitles to compensation. How this difficulty has been overcome I shall describe later.

With the exception, therefore, of fibroid phthisis (silicosis) the intention of the government was to schedule every strictly industrial disease which complied with the principles of selection. This explains inclusion of some extremely rare diseases, such as nickel carbonyl poisoning, poisoning from African boxwood, manganese poisoning, and exclusion of the group of ordinary infectious illnesses—measles, scarlet fever, etc.—when contracted by a laundry worker, for example, through chance exposure to infection.

At the outset I want to say how much help the Committee received from Trade Union Secretaries. At least three of the diseases were scheduled largely as the result of evidence heard from them—glassworkers' cataract, epitheliomatous ulceration, and poisoning from African boxwood.

I have shown in Charts VIII, IX and X some of the principal maladies over the years for which compensation figures are available—1908-1914 and 1919-1926—bringing out thereby their tendency to rise. And here again I would say the charts are drawn to show the peaks and the contrasts. The actual figures for each year for (1) new cases in the year which are shown black; and (2) cases carried on from previous years (shown grey) are given in appendix 3. The number of cases to the square and the scale generally of charts VIII and IX is the same as in No. I. Of the eleven notifiable diseases, therefore, comparison can be made of the number that received compensation and the number that were notified. According to the published statistics of compensation the number obtaining compensation is always less than the number notified. This must mean either that several are settled without formality, or that the workman does not trouble to make a claim perhaps for fear of losing his job. For this Act is the Cinderella among Acts of Parliament, as it is no person's duty to see that its requirements are fulfilled. Even the person most qualified to do so, the factory inspector, is enjoined not to touch it.

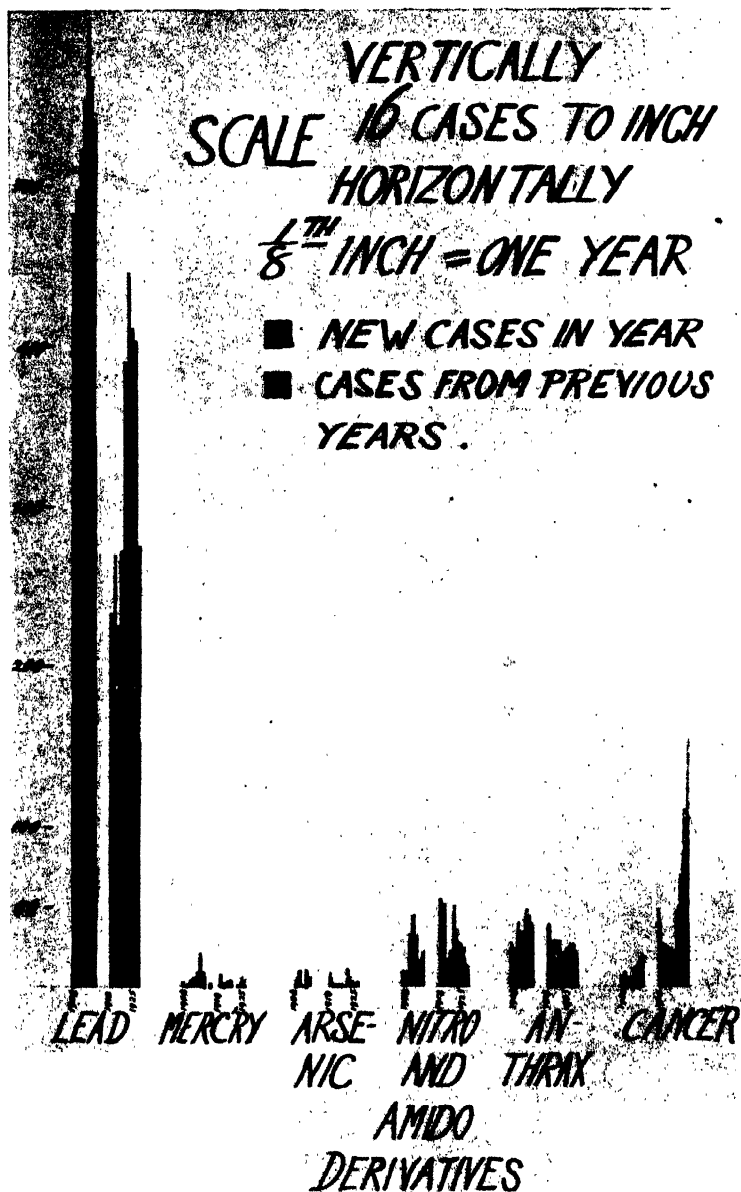


CHART VIII.

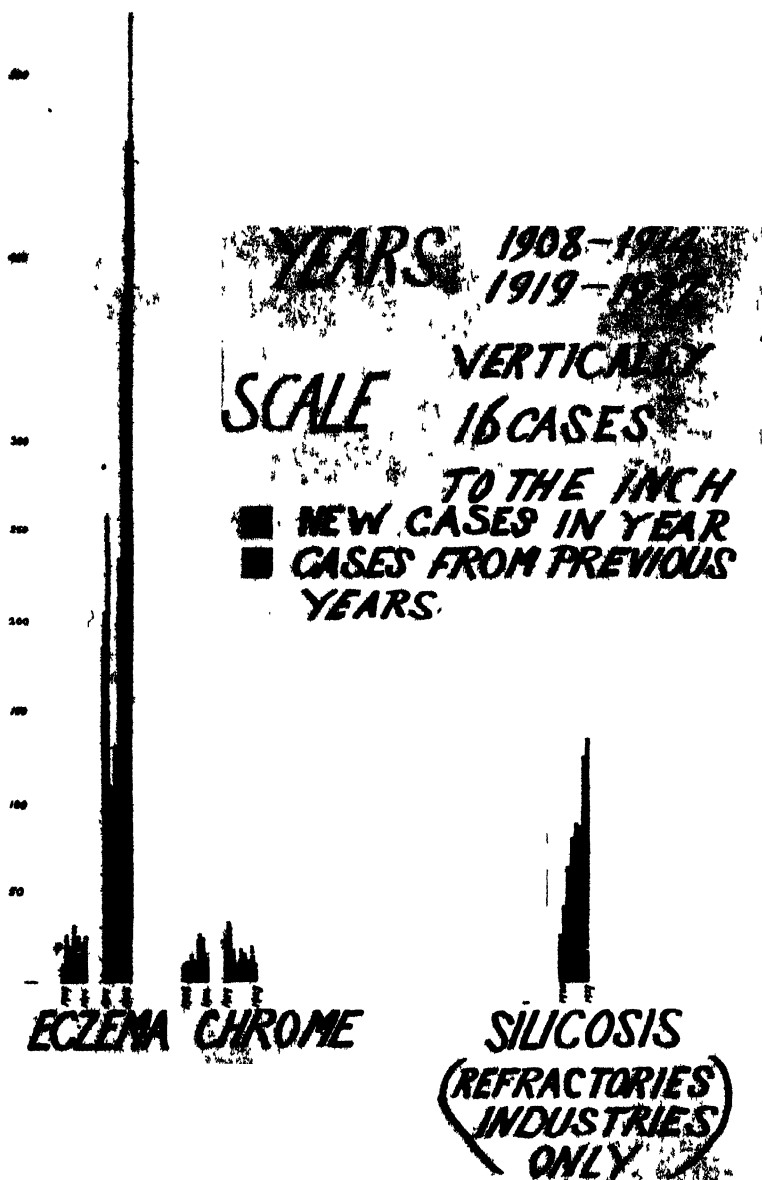


CHART IX

When we come to deal with miners' maladies, so many are they that the scale of Chart X for them has been reduced eight times as compared with the factory cases.

One interesting thing brought out is how the figures show at a glance which are the chronic maladies, like lead poisoning and miners' nystagmus, and which the acute, like all the others nearly, the light grey representing cases carried over from previous years and not deaths as in charts I, II and III. Thus the remarkable contrasts between some, like skin cancer and miners' nystagmus, and others like beat hand. The cases (both new and old) of cases of compensation for skin cancer have risen from 7 in 1908 to 74 in 1927, the last year for which statistics are published, those from dermatitis and eczema from 270 in 1919 to 1047 in 1927, and from silicosis (for the refractory industries alone) from 51 in 1919 to 269 in 1927. Miners' maladies constitute over 90 per cent. of the total cases due to occupational diseases scheduled under the Act.

Consider for a moment the amount of invalidity represented by the figures for lead poisoning alone. Plumbism is a chronic malady involving disability in the acute cases for four weeks—seldom less—and in the severe chronic cases for months. Taking an average absence from work of two months per case, the figures for 1914 alone represent ninety years of lost time, to say nothing of the disorganisation of home life brought about by the illness.

From time to time as experience and outside pressure has shown to be desirable, the description of the scheduled diseases has been altered. This has always been in the direction of widening the scope so as to enable the workman to obtain compensation more easily. The first Committee which drew up the list was inclined, not wishing to take a leap in the dark, to make the right to claim compensation not too easy. Thus "eczematous ulceration" was scheduled, intending thus to indicate that dermatitis was not quite the same thing. Later experience showed that dermatitis was really in distinguishable from eczematous ulceration or, at any rate, that those suffering from it were as much deserving of compensation as for the graver condition, and now the description of the disease has been altered to "(a) dermatitis, and (b) ulceration of the skin produced by dust and liquids." Similarly, poisoning by "nitro and amido derivatives of benzene" was not wide enough to include T.N.T., and it was necessary to alter the schedule to read "nitro and amido derivatives of benzene *and its homologues*."

Are any other maladies ripe for scheduling? I think there are two (1) chronic poisoning by sulphuretted hydrogen gas, which sets up tiresome irritation of the eye and the symptoms of "sick headache" among those exposed to traces of it in the air of chemical and artificial silk works; and (2) asbestosis which will have to be dealt with on precisely the same lines as silicosis with which in its symptoms and terminal phase of tuberculosis it somewhat resembles.

Much romance attaches to the manner in which some of these maladies finally, in spite of much contradictory evidence, came to be scheduled. Mr. Alfred Greenwood, the partially blind Secretary of the Glass Bottle Makers of Yorkshire United Trade Protection Society, had noticed, his inquiries starting in 1891, how frequently cataract was signalled as the cause of incapacity which brought members on the superannuation funds of the society—a notable instance of the value of the material in such Society records, if only they are properly used. Later a new Eye Hospital was opened at Sunderland, and Dr. W. Robinson¹ described in 1903 how the cases of cataract which came before him among glass bottle finishers (who spent their time exposed to the glare from the glory hole of the glass furnace at a temperature of about 1,500° C.) were all of a particular type—a posterior cortical cataract commencing right in the optical centre of the eye. These facts and other statements which conflicted with them, were given in evidence before the Committee and made it difficult—nay, impossible—to schedule the condition with the others at the time of reporting.

I was deputed to try and settle the question of whether the malady should be scheduled or not. For that purpose I examined the crystalline lenses of 513 glass workers exposed to the glare and heat and, as a control, of 278 as I thought, not so exposed. The difference in the character of the changes observed was very striking and of unmistakable significance. Thus of the control persons none had sought treatment for cataract and in not more than three were the opacities such as to impair sight. Among the glass workers, in addition to six in whom a single extraction for cataract had been performed, and in one, a double extraction, there were at least 25 others in whom the sight of one or other of the eyes was seriously impaired. Typical central posterior cortical change of varying degree was noted in 56 lenses of the 513 glassworkers and in two of the 278 control persons examined.

The only one with clearly developed posterior cortical cataract among the controls was a worker at Woolwich Arsenal who turned out to have been engaged for years in looking after an annealing furnace—on work similar to that of the glass finisher. He was, therefore, the exception which proved the rule.

Approaching the problem from another side—that of superannuation from disablement by cataract—I found that useful comparison could be made between the reported incidence of the malady on 10,549 members of the Hearts of Oak Benefit Society in receipt of reduced sick allowance and that on 186 superannuated members of glass-bottle societies. The percentage of cataract in the former was only 0.78, and in the latter 22.6, although the average age in both was about the same—56 years.

¹ His paper, together with other literature on Glassworkers' Cataract, is printed in full in the Second Report of the Committee on Compensation for Industrial Diseases (Cd. 4387), 1908.

There could be no hesitation now in scheduling the disease unless it should prove to be against the interests of the workers themselves on account of the probable effect of such a course upon the prospects of employment of the men affected. The disease is one of very slow growth. For many years the efficiency of the workman at his trade is little, if at all, affected. During that period it would be impossible for him to claim that the disease had incapacitated him and that he ought to be compensated. But at any time an ophthalmoscopic examination of the eyes would clearly reveal the disease in an incipient stage, forecasting the possible ultimate incapacity of the workman. If the law required that half-wages should be paid during the rest of the life of an artisan who had lost his technical skill through cataract, it would not be unnatural to expect that employers would insist that their men should submit to an examination of the eyes; that no employer would engage a workman, seeking employment, who showed traces of the malady; and that some employers would even dismiss workmen so affected before the time arrived when a claim for compensation could be established.

The Committee came to the conclusion that if the disease were scheduled in the same manner as other industrial diseases, the work people would lose more than they would gain, as the employers might require them to undergo an ophthalmological examination, and the presence of the black dot in the centre of the pupil would be an indication for dismissal long before the disease was incapacitating. The surgical operation of removal of the cataract would come to the rescue primarily of the sufferer, but secondarily of the Committee in helping to a decision of how the malady should be dealt with for purposes of compensation. The operation for the removal of cataract is attended by practically no danger, and among glassworkers usually enables them to obtain employment again, sometimes even at the highly-skilled work on which they had been formerly engaged. If the period in respect of which compensation were made payable were limited to the time necessary to cover the period of incapacity immediately preceding and succeeding the operation, a just relief would be given to the workmen, while the burden on the trade would be reduced to such very small proportions that no employers would incur the expense of arranging for periodical medical examinations or be guilty of the harshness of dismissing men whom they knew to be suffering from a slowly-ripening cataract. The Workmen's Compensation Act enables such a limitation to be effected without further legislation, so the disease was scheduled for a period not exceeding six months, and for not more than four months unless an operation for removal was undergone.*

* The conditions under which cataract is now scheduled under the Workmen's Compensation (Industrial Diseases) Consolidation Order, 1929, is as follows:—

A person suffering from cataract shall not be entitled to compensation under the provisions of the said section on account of that disease for more than six months in all, or for more than four months unless he has undergone an operation for cataract.

Provided that where the judge, committee or arbitrator is satisfied on the advice of the medical referee that an operation could not for medical reasons be performed within four months from the date of disablement, or that having undergone an operation, the worker is still disabled by the cataract after the expiration of six months from such date, compensation may be continued for such further period and subject to such conditions as the judge, committee or arbitrator may direct, without prejudice, however, to the right of review conferred by section 11 of the Act.

But that is by no means the end of the romance. I had to admit after my inquiry that I could not say whether the changes in the lens were caused by the light or the heat rays. That was a problem to be solved by a physicist and not by a medical man. Fortunately the great physicist Sir William Crookes, then in his 77th year, became interested in this aspect. He visited glassworks, finding the heat rays in the radiation from molten glass in far greater abundance than the ultra violet, and from this he inferred that it is to the heat rays rather than the ultra-violet that glass workers' cataract must be ascribed. He set himself the task of adding various metallic oxides to the constituents of glass in order to cut off the invisible rays at the ultra-violet and the infra-red ends of the spectrum, i.e., to cut off those rays which are believed to damage the eyes without, at the same time, obscuring too much light. Finally, he was able to prepare glasses cutting off 90 per cent of heat radiation, opaque to the invisible ultra-violet rays, and sufficiently free from colour to be scarcely noticeable when used as spectacles. The glasses he describes "include specimens suitable for spectacles adapted to all requirements—from eyes of youth to eyes of age."

Here was the remedy, you will say. Yes—but unfortunately the wearing of goggles is not a means external to the workman over which he can exercise no control. A very careful man might wear them—one, too, who had had the misfortune to lose one eye and wanted to do everything to save the sight of the other—but, generally speaking, with a disease so gradual in its onset and with a remedy having the disadvantage of allowing the sweat to condense on them—glass-finishing is unbelievably hot work—the remedy failed of its intention. Welcome, therefore, to that wonderful machine, the product of American inventiveness, and a means wholly external to the workman, which sucks up automatically the molten metal, automatically carries it to a mould where automatically the bottle is blown and delivered at the rate of forty a minute at a cost in labour about one-ninth that paid for the same number of bottles manufactured by forty men and four boys in the old way. This is the right way of tackling an intractable industrial malady, because, really, no man ought ever to have been asked to carry on glass-bottle making in the way it had to be carried on under a competitive system. Only one thing the machine could not do, and that was to put the glass marble inside the neck of the ginger-beer bottle. That had still to be done by sleight of human hand. Every incandescent electric light bulb is to-day blown by machinery.

What I have described is only a part of the story, as other scientific research work has been carried out under a Committee of the Royal Society.

My inquiry was limited to the work of glass-blowing, but I always felt that if only one had time to follow the same line of inquiry up in other industries, such as iron and steel manufacture, where there is similar exposure to glare from hot furnaces, the same result would be found. This was reserved for Dr. Healy, of Llanelli, to do. He went there, after having held the position

of house surgeon to Dr. W. Robinson in the Sunderland Eye Hospital, and, sure enough, he found what he looked for in the iron and steel rollers. Now cataract caused by "exposure to rays from molten or red-hot metal" has also been scheduled.

Another Trade Union secretary hurled, metaphorically speaking, a chunk of South African boxwood at the head of the Professor of Botany in Liverpool University, and asked him what it contained to cause the men to feel mazy and dopy, so that they nearly fell off their bench. One indeed said that "he could sleep on a clothes' line." The late Professor Harvey Gibson, with the help of Professor Sherrington (now Sir Charles Sherrington, O.M.), put their heads together and discovered an alkaloid in the wood which was a cardiac poison, inducing a gradual slowing of the heart-beat, that accounted for the symptoms complained of. Now other wood has been largely substituted, because, at the speed which modern machinery works in the making of shuttles that being the use to which the wood was put - even with the best system of locally-applied exhaust ventilation, some dust must needs be inhaled.

The late Mr. Wignall, M.P. for the Forest of Dean, then Organising Secretary of the Dockers' Union in South Wales, first brought to the notice of the Committee on Compensation for Industrial Diseases the distressing symptoms due to the irritant action of pitch dust on the patent fuel workers in Swansea and Cardiff. It was brought poignantly before them by seeing an Alderman of the City of Swansea, himself a pitch-worker and himself the victim of skin cancer, from which soon afterwards he died. I was also deputed to investigate this condition, and found a true bill, not only in the case of the briquette workers, but also in the case of those using "coal oil" in the manufacture of grease. This also is a very slow-growing condition, in which, once the seeds are sown, even giving up the work will not stay its development. It is really a centuries-old malady, but was thought to be confined to chimney-sweeps. Regularly the Registrar General's Decennial Supplement on Occupational Mortality brought out the high mortality from cancer of the scrotum among chimney-sweeps, but his classification of occupations failed to bring out, as it has enabled him to do in his last Supplement, that other occupations using "tar, pitch, mineral oil or paraffin, or any compound, product or residue of any of these substances," also suffered in the same way as I have already sufficiently described.

These are but examples of the romance underlying the scheduling of a disease under the Workmen's Compensation Act. I can only deal briefly with one more, and that one, perhaps, the most difficult of all, namely, silicosis. The flint knappers in the palæolithic and neolithic epochs must have been the first sufferers. The grinders of armour and of implements of war and the pottery makers in the middle ages yielded, as Ramazzini tells us, their quota. And in the building of cities like Edinburgh and the Yorkshire cities of freestone and sandstone thousands of masons' lives must have been sacrificed. Only

recently, following on the success with which its devastating effects had been combated in the South African gold mines by watering and medical supervision, was it brought home to us seriously as a malady, entitling to compensation, which we ought to tackle. A few of the names which will be remembered for pioneer work in this field are Watkins Pitchford and Mavrogordato in South Africa, Collis, Haldane, Middleton and Hall in Great Britain, and Chapman and Badham in Australia.

Fortunately, not all stone dusts cause silicosis. Limestone, Portland stone and oolitic stone, such as bathstone, are comparatively harmless. The more free silica a stone contains the more harmful will it be. Free silica would appear to be inherently wicked, by which I mean that it won't let the dust cell in the air vesicle of the lung, when trying to remove it, do its work. So obstructions to the channels of removal occur, they aggregate and become the starting point for the formation of fibrous nodules which, coalescing, diminish the amount of lung space available for oxygenating the blood. But this is not the worst thing that happens, for this damaged lung becomes a suitable soil for the development of the tubercle bacillus when it gets in. The terminal phase of the disease, generally after the twentieth to the thirtieth year of employment, is silicosis accompanied by tuberculosis.

Progress has been made in bringing this disabling condition under the Workmen's Compensation Act. Serious practical difficulties, to which I have already referred, led the Committee on Compensation for Industrial Diseases to recommend that the question of scheduling it should be kept in abeyance for the time being. In 1917 pressure was again brought to bear on the Home Office to deal with the subject owing to the success of the Miners' Phthisis Acts in South Africa. As a result a method was devised for dealing with the difficulties of the situation in this country by "schemes," each applicable to a particular industry or group of industries.

At present four schemes are in operation—the Refractories Industries Scheme, the Metal Grinding Scheme, the Various Industries Scheme and the Sandstone Industries Scheme. Perusal of the four schemes brings out what appears to be a strange inconsistency: those for the Refractories and Sandstone Industries embrace compensation for partial incapacity as well as for death and total incapacity, while the other two are restricted to death and total disability. The reason, of course, is mainly the burden placed on an industry by the payment of claims continued over a period of years in cases of partial disability, involving a levy perhaps of 5 or 6 per cent. on the wages bill from the employers in the particular industry. But, further, in these schemes a profound difference is to be observed in the way in which compensation is obtainable by the workman. Thus, in the two schemes with compensation for partial incapacity this is obtainable only through certification by a medical board, while in the other two compensation is obtainable through certification by the factory surgeon, with the usual

right of appeal, either by the employer or workman, to a medical referee. Now the unsuitability of the certifying factory surgeon for diagnosing cases that involve claims for silicosis is self-evident. It is not that he would not be right in most cases, but that he would never be sure that he was, since he has to make his diagnosis at a single interview (at a fee of 5s.) without the aid of an x-ray photograph. The Various Industries Scheme, which has just come into force, adopts the discredited rule of restricting compensation to death and total incapacity, whereas the Sandstone Industries Scheme, of a later date, handsomely expresses readiness to recognise partial incapacity as rightly entitling to compensation. To be fair one ought to say that the late Home Secretary was evidently aware of the Gilbertian quandary, and the appointment of the Silicosis (Medical Arrangements) Committee is a gallant effort at extrication.

Yet another scheme is in preparation—that for the Pottery Industry. The preliminary survey* by Drs. C. L. Sutherland and S. Bryson—members of the medical board appointed under the Refractories Industries Scheme—brought out the fact that of 72 elderly men exposed to unmixed flint dust 47 were found with fibrosis, and of 49 of those examined radiologically 23 showed silicosis. A similar survey by the same highly qualified medical men of their clinical examinations of 461 men (of whom 281 were radiologically examined) working on sandstones has recently been made. In this inquiry the examinations were confined to men employed at the time, no cases of persons already disabled being included, but relatively higher proportions were included of those who had worked for longer periods. The disturbing fact emerges that among masons, quarrymen, and wallstone dressers, about 50 per cent. showed positive evidence of silicosis radiologically. The critical period appears to be between twenty and thirty years of employment. A concluding statement in the latest report by Drs. Sutherland and Bryson is important as pointing to real prevention of the trouble by bringing an influence to bear external to the workman—that is, one over which he can exercise no control—namely, a very effective “device for the application of localised exhaust draught for removal of dust produced by pneumatic surfacing tools.” This obviously means that a method has been discovered for utilising for this purpose the compressed air necessary in the work.

Silicosis is a world-wide problem, the extent of which has only been brought into prominence quite recently among the granite workers of Vermont, U.S.A., among the blasters, excavators and drillers of New York City, among the miners of Broken Hill and the tunnellers of Sydney in Australia, and on the Continent of Europe; so that the announcement which was made in March last of an international conference of experts to be held at Johannesburg in August, 1930, is to be welcomed.

* *Report on the Incidence of Silicosis in the Pottery Industry* London H M Stationery Office. 1926 1s 6d net

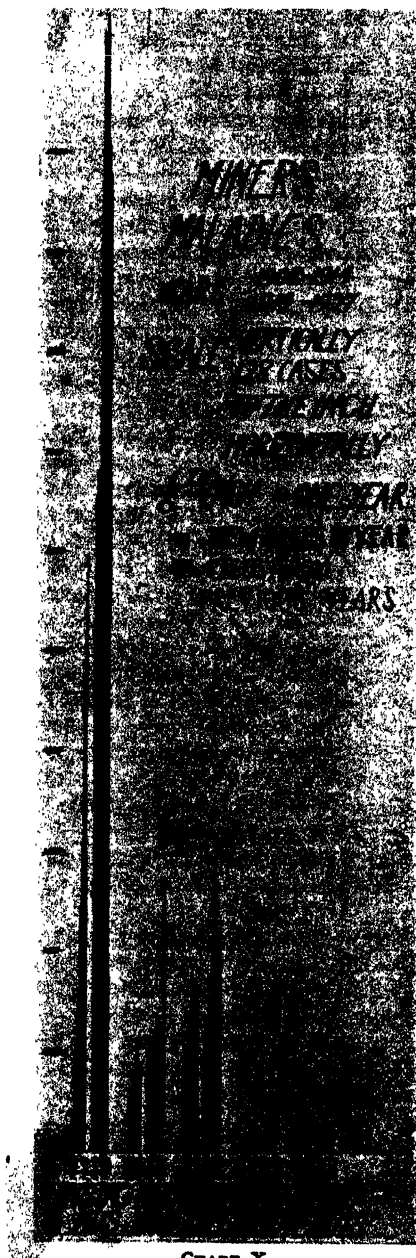


CHART X.

Closely allied with silicosis is a somewhat similar condition which has been shown conclusively to be due to the inhalation of asbestos dust. Asbestos is the mystery mineral, crystalline yet fibrous so that it can be spun and woven like a textile material. It is a silicate of magnesium—a disconcerting fact, showing that it is not the presence of free silica alone which can give rise to fatal lung changes. Another mystery about asbestosis is also still unsolved. It is the presence, shown microscopically, in all fatal cases of curious golden yellow bodies, in relatively quite large numbers, not unlike, although they cannot be, the sporangia of certain moulds. These remarkable bodies were first described by Dr. W. E. Cooke,⁴ Director of the Pathological Department of the Infirmary, Wigan. Asbestosis will have to be treated in the same way as silicosis for purposes of compensation.

I have given you an outline now of the principal maladies which I have had to deal with, and pass to another quite different group, the mining group—which accounts for so large a proportion of the claims—nystagmus and the acute infections, heat hand, knee and elbow. They have not, however, come within my purview, although I have read a great deal and heard a great deal of evidence about these maladies. All that I have heard confirms to my mind the view that miners' nystagmus is a vast neurosis in which auto-suggestion, unfortunately, cannot help but play an important part, due to the strain of working underground. And I am persuaded, too, by the evidence adduced by my predecessor in these lectures, Dr. J. S. Haldane, C.H., and that of Dr. Llewellyn, working with him, that the remedy for it is to be found mainly in bringing an influence to bear external to the workman, namely, much better mine illumination. Perhaps that will come through improvement in miners' electric caps, which, with the provision of an adequately designed fuse the latest report states, would make impossible any short circuiting of the battery. If a Government Department can ever be oppressed by the feeling of regret or remorse I cannot but think the Home Office must feel it in not having created a Medical Inspector of Mines many years ago. What could he not have accomplished!

⁴*Brit. Med. Journ.* July 26th, 1924, and Dec. 3rd, 1927.

APPENDIX III

"TWENTY YEARS EXPERIENCE OF COMPENSATION FOR
INDUSTRIAL DISEASES"CASES OF INDUSTRIAL DISEASE FOR WHICH COMPENSATION
WAS PAID *

A—Cases continued from previous years

B—Cases in which first payment made during year

Disease		1908	1909	1910	1920	1921	1922	1923	1924	1925	1926	1927
Anthrax	A	4	2	6	2	3	—	5	2	2	4	5
	B	23	22	35	26	8	28	19	23	25	26	20
Mercury Poisoning or its Sequela	A	—	—	2	—	—	—	—	2	2	—	2
	B	3	1	2	2	3	4	1	3	4	5	1
Phosphorus Poisoning or its Sequela	A	—	—	—	—	—	—	—	—	—	—	—
	B	1	1	—	1	—	—	1	1	1	—	1
Arsenic Poisoning or its Sequela	A	—	2	—	2	—	1	—	6	3	2	1
	B	15	4	10	1	2	1	1	6	4	2	3
Lead Poisoning or its Sequela	A	61	146	152	96	84	116	154	164	177	169	121
	B	421	351	367	169	146	157	236	285	234	177	154
Poisoning by Benzene and its Homologues or the Sequela	A	—	—	—	—	—	—	—	—	—	—	—
	B	—	—	—	—	6	1	—	1	2	—	—
Poisoning by Nitro and Amido Derivatives of Benzene, and its Homologues or the Sequela	A	—	1	5	—	—	1	3	10	6	7	3
	B	10	8	28	52	9	20	46	23	18	17	27
Poisoning by Dinitro phenol or its Sequela	A	—	—	—	—	—	—	—	—	—	—	—
	B	—	—	—	1	—	—	1	—	1	—	—
Poisoning by Nitrous Fumes or its Sequela	A	—	—	—	2	—	—	—	2	2	1	1
	B	—	—	1	19	2	4	7	4	4	3	7
Dope Poisoning	A	—	—	—	—	—	—	—	—	—	—	—
	B	—	—	—	—	—	1	—	—	—	—	2
Poisoning by Tetra- chloroethane or its Sequela	A	—	—	—	—	—	—	—	—	—	—	1
	B	—	—	—	—	—	—	—	—	—	—	—
Poisoning by Carbon Bisulphide or its Sequela	A	—	—	—	—	—	—	—	—	—	1	—
	B	—	1	—	1	1	—	—	2	—	—	—
Poisoning by Nickel (Carbonyl or its Sequela	A	—	—	—	—	—	—	—	1	—	—	—
	B	—	—	—	—	—	1	7	2	16	—	—
Poisoning by <i>Gonoma</i> <i>Kamayi</i> (African Boxwood) or its Sequela	A	—	—	—	—	—	—	1	—	—	—	—
	B	—	—	1	—	—	—	—	2	—	—	—
Manganese Poisoning	A	—	—	—	—	—	—	—	—	—	—	4
	B	—	—	—	—	—	—	—	—	—	4	—
Dermatitis from dust or liquids	A	—	—	—	13	30	24	45	72	94	125	133
	B	—	—	—	395	131	196	345	492	597	712	909
Ulceration of the Skin from dust or liquids	A	1	5	4	12	10	7	11	6	18	14	8
	B	19	42	30	91	45	36	70	58	63	58	31
Ulceration of Mucous Membrane of the Nose or Mouth from dust	A	—	—	—	1	—	—	—	—	1	1	—
	B	—	—	—	—	1	1	—	—	1	1	3

Disease.		1908	1909	1910	1920	1921	1922	1923	1924	1925	1926	1927
Epitheliomatous Cancer, etc.	A	2	—	—	6	4	7	7	7	17	24	19
	B	5	4	4	16	19	14	15	12	49	85	55
Ulceration of the Corneal Surface of the Eye.	A	—	—	—	3	—	3	1	1	1	3	3
	B	—	—	—	17	—	8	1	—	4	2	16
Scrotal Epithelioma (Chimney-Sweep's Cancer.)	A	—	—	—	—	2	1	1	—	2	2	43
	B	1	5	2	5	1	2	—	28	2	2	38
Chrome Ulceration or its Sequela.	A	1	—	10	4	12	4	11	10	9	5	7
	B	20	23	20	63	24	16	27	23	17	30	14
Compressed Air Illness or its Sequela.	A	1	2	1	—	—	1	—	1	1	1	1
	B	10	2	2	1	2	—	2	3	16	9	—
Cataract in Glass-workers.	A	—	—	1	1	2	1	1	1	1	—	1
	B	—	—	2	1	2	2	6	3	2	2	1
Cataract caused by Exposure to Rays from Molten or Red Hot Metal.	A	—	—	—	—	—	—	—	—	3	2	8
	B	—	—	—	—	—	12	7	9	8	8	11
Ankylostomiasis	A	—	—	—	—	—	—	—	—	—	1	—
	B	6	8	7	—	1	1	—	—	1	—	—
Miners' Nystagmus	A	74	380	662	4163	4804	5063	7273	7635	7890	8270	7934
	B	386	631	956	2865	1913	4092	3883	3271	3445	1771	1802
Subcutaneous Cellulitis of the Hand (Beat Hand).	A	28	20	32	47	54	82	110	103	81	109	298
	B	464	573	774	763	806	1183	1244	1137	1197	1151	2461
Subcutaneous Cellulitis or Acute Bursitis arising at or about the Knee (Beat Knee)	A	29	29	33	67	72	94	147	169	140	161	107
	B	539	881	1136	1322	896	1723	2640	2743	2603	1392	2202
Subcutaneous Cellulitis or Acute Bursitis over the Elbow (Beat Elbow).	A	8	6	2	14	11	13	36	19	15	31	12
	B	67	63	80	123	101	202	302	309	302	203	355
Inflammation of the Synovial Lining of the Wrist Joint and Tendon Sheaths.	A	—	5	10	5	3	9	18	10	9	8	26
	B	87	128	95	75	78	186	192	190	204	174	253
Glanders	A	—	—	—	—	—	—	—	—	—	—	—
	B	—	—	1	—	—	—	—	—	—	—	—
Writers' and Telegraphists' Cramp.	A	—	—	—	—	—	1	—	—	—	—	—
	B	—	—	1	3	2	2	2	—	1	2	2
Twisters' Cramp	A	—	—	—	—	—	—	—	—	—	—	—
	B	—	—	—	—	—	1	1	—	2	1	—
Inflammation, etc., of the Skin and Subcutaneous Tissues, due to Exposure to X-Rays or Radio-Active Substances.	A	—	—	—	—	—	—	—	—	—	—	—
	B	—	—	—	—	—	—	—	—	—	—	—
Silicosis (Refractories Industries).	A	—	—	—	7	39	64	115	138	147	194	234
	B	—	—	—	44	44	62	42	37	34	55	35

* In the published Statistics of Compensation for the year 1927 an error occurred in attributing 18 B cases to Dimittophenol which should have been placed under Nitro and Amido derivatives of Benzene, and 1 old and 9 new cases to Manganese poisoning which should have been included under Dermatitis. This has been corrected in the Table above.

OBITUARY.

LORD NEWLANDS, LL.D.—Lord Newlands, who died on September 5th, at the age of 78, at Barrowfield Lodge, Brighton, was elected a Life Fellow of the Society in 1912, and served as a Vice-President and Member of the Council for the period 1915-17.

James Henry Cecil Hozier was born at Tannochside House, Lanarkshire, in 1851, and was educated at Eton and Balliol College, Oxford. After serving in the Foreign Office from 1874-8, he became Private Secretary to the Marquess of Salisbury, when Foreign Secretary, from 1878-80, and again, when Prime Minister, from 1885-6. For twenty years (1886-1906) he sat as Conservative M.P. for South Lanarkshire, when he succeeded to the barony on the death of his father, the first Lord Newlands.

Lord Newlands took a deep interest in education and philanthropy. In 1907 he presented a large sum of money to Balliol College to found the Jowett scholarships and in the following year he also founded the Newlands scholarships. He was elected an Honorary Fellow of the college in appreciation of his gifts. His name was also associated in many directions with philanthropy and public service in Glasgow and Lanarkshire. As President of the Territorial Force of the county he supported every movement for the national weal, especially after the outbreak of the Great War, devoting himself unsparingly to the raising of troops, the collection of relief funds, and the alleviation of suffering. He endowed the Lady Hozier Convalescent Home in Lanark in memory of his mother, and made various gifts of recreation grounds and open spaces.

He was Lord Lieutenant of Lanarkshire from 1915-21, a Public Works Loan Commissioner since 1900, and a Brigadier in the Royal Company of Archers, the King's bodyguard for Scotland. In 1917 he was made a freeman of the city of Glasgow, and he also received the degree of LL.D. from Glasgow University.

NOTES ON BOOKS.

THE CITY OF TO-MORROW. By Le Corbusier. Translated by F. Etchells. Rodker. London. 25s.

M. le Corbusier is to town-planning what Prince Kropotkin was to agriculture. He is a very important person. He is putting forward proposals which may seem startling to-day, but which will have been adopted and taken for granted to-morrow. People will be as amazed in 2030 to think that the nineteenth century could have tolerated slums and jerry-built suburbs, as we are to-day when we are reminded that in the eighteenth century men were hanged for stealing a sheep.

M. le Corbusier is not an impetuous youth. He is an experienced practising architect, who has succeeded in imposing his ideas, his houses—not yet his city—on a number of European municipal bodies. He has already gone far. He is no longer "playing a lone hand." He is to be found on committees. He is followed by some architects, imitated by others. It is recognised by a respectable minority that he is equipped with the sort of brains and vitality that serve reason in the battle against prejudice.

Urbanisme, here admirably translated by Mr. Etchells, is singular both for its content and its expression. Though the author says that "nothing is going to make a politician" of him, providence made anything but a pure and simple architect of him. He is philosophically inclined; his mind seethes with general ideas. Happily one of these is that enunciated by Pythagoras: "Man is the

measure of all things." This is why M. le Corbusier's sky-scrapers are going to be unlike the sky-scrapers of New York.

The author's jottings have a Leonardesque variety; they also suggest Vachel Lindsay. And if from time to time M. le Corbusier carries us with him to the peaks of his vision, he soon bumps us down gently but firmly on a table of statistics. Appended we find notes by a civil servant, one of a class from which purple patches are not to be expected.

Critics have found that shafts aimed at the master are apt to recoil against themselves. A gentleman, discussing *Vers Une Architecture*, wrote: "Is the next generation really destined to pass its existence in these immense geometrical barracks . . . conveyed at the same hours by the same trains to the same sky-scrapers?" M. le Corbusier, having dealt with the objection to geometrical design, rounds amusingly on the journalist. "You are not going to make me believe," he says, "that up to the fatal moment when my book was published trains started at any old hour, arrived when they liked, and once they arrived were broken up and burnt, so that other trains could be employed the next day!"

M. le Corbusier is clearly right in maintaining that we suffer to-day not so much from Order as from Disorder. It is a feeling of the uncertainty of life, not its monotony, that weighs so heavily on our urban populations. The monotony is there, too; and M. le Corbusier believes that the Order which he proposes will give contemplative satisfaction as well as a new stability to our civilisation. We cannot rely solely on education to provide a higher plane of understanding for all and sundry. Education, culture, is strangled in its infancy if opportunities for expression are lacking. The plight of educated men and women under hopelessly unpromising conditions is worse than that of phlegmatic barbarians.

Opportunities depend in the first place on the right organisation of the fundamental necessities of life—Kropotkin's province. In the second place they depend on the right organisation of the human environment—M. le Corbusier's province. Efficiency and hygiene must not be confused with culture, as they sometimes are in Anglo-Saxon countries, but at least they are the second best thing, and, in the long run, a means to the higher end, as well as being an end in themselves. M. le Corbusier's idealism is never naïf; he does not exasperate the honest sceptic with anticipations of a humanity that has been reformed by him. It is the external world that he wants to reform; afterwards perhaps humanity will find it easier to reform itself.

Kropotkin drew up a scheme for the intensive cultivation of the soil. M. le Corbusier's City of the Future is also a matter of intensiveness. The business quarter of the City is to consist of sky-scrapers sixty storeys high. This quarter is to be at the heart of the City, the actual centre of which will be an air port and railway station. Now the only advantage of sky-scrapers is that they may be used to relieve congestion, and so make it possible keep even the busiest part of an urban area open to sun and air. By far the greater part of M. le Corbusier's City is made up of open spaces, laid out as gardens and planted with trees. The sky-scrapers represent intensive building at those points where most work can most conveniently be done. By concentrating the different categories of traffic on different super-imposed levels, immeasurably greater facility of communication than now exists will make any attempt to encroach upon the open spaces unthinkable.

In this book the plans for the City are worked out in some detail, and economic considerations are dealt with, though more briefly. There is a chapter at the end describing what is called the "Voisin" plan for the rebuilding of an overcrowded and slummy region in Paris, and its harmonisation with the work of Haussmann and the great eighteenth century architects.

The subject, and M. le Corbusier's treatment of it, are of the profoundest interest. For the limited progress in which reason allows us to believe depends for its realisation on deliberate human action directed to definite ends. Tolerable working conditions having been secured, there remains to be dealt with that problem of the employment of leisure which has got to be solved for the millions before any industrial country can become really civilised. The more that working hours are reduced, the more necessary will it be to secure for all cheap art and cheap exercise. This is as obvious as the superiority of trial by jury to trial by battle, but unfortunately bad systems have a way of lingering on.

It will be seen that if ninety per cent. of the area of a city is open space, there will be no difficulty about providing play-grounds for children and sports grounds for adults. Little boys in back streets would no longer have to play their precarious cricket under the wheels of lorries, amid dust and dirt. The average health of the community would go up. The demons of smoke and noise having been exorcized, city life would recover an element of reposefulness, without which it has in the last twenty-five years become intolerable.

England must not postpone designing her Cities of To-morrow. Already a wise Bill for the regulation of town-planning has been prepared for the French Chamber, a Bill that shows traces of M. le Corbusier's growing influence. P.B.

THE COUNTY ANTHOLOGIES. (1) Yorkshire. By G. F. Wilson. (2) Derbyshire. By Thomas Moul. (3) Lanarkshire. By Hugh Quigley. London: Elkin Mathews and Marrot, Ltd.

Messrs. Elkin Mathews and Marrot have been happily inspired in planning this series of anthologies of which the three above mentioned have now been published. Each volume will contain an anthology of prose and verse devoted to one particular county, and its preparation will be entrusted to a well-known man of letters with a special interest in that county. While the anthologies will appeal to the general reader, they are intended primarily to have an educative influence on boys and girls, and to foster in them an appreciation and love of their native surroundings. As Professor Cowl, the general editor, writes in the preface to "Yorkshire": "For the young a literature that invests with imaginative beauty familiar scenes and objects may prove to have a more compelling appeal than the wider literature that treats of things remote from their experience and sympathies." Charity is not the only thing that begins at home. The boy who has learnt to appreciate the beauties of his native village and his native county should be able to extend his appreciation to the beauty of his native land and soon until he can understand and love beauty wherever it may be. With this end in view it is hoped that each anthology may find its way into the schools of the county with which it deals, and accordingly the volumes are issued in three forms—one at 2s. 6d. for schools and classes, and two more luxurious at 3s. 6d. and 6s. net.

The three volumes before us, sponsored as they are by literary men of standing, are all admirable, and the selection of pieces most discriminating. The Derbyshire boy who reads Michael Drayton's "The Wonders of the Peak," the Yorkshire lad who reads his "Most Renowned of Shires," should feel a fresh pride in his county. It was never more necessary to inculcate love of our matchless countryside than now, when it is threatened by a thousand dangers, and if these anthologies do their work as they should, in the rising generations we should find plenty of support for schemes for the preservation of rural England, and for such enterprises as the Royal Society of Arts has undertaken in the saving of our most beautiful old villages.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4009.

VOL. LXXVII.

FRIDAY, SEPTEMBER 20th, 1929.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.(2.)

NOTICE.

HISTORY OF THE ROYAL SOCIETY OF ARTS.

Further copies of the History of the Royal Society of Arts by the late Sir Henry Trueman Wood, the existing supply of which was recently exhausted, are now available, and can be obtained, price 15s. net, on application to the Secretary. The History, a large octavo volume of 558 pages with a large number of illustrations, gives a well documented account of the many and various activities of the Society from its foundation in 1754 to the year 1880.

PROCEEDINGS OF THE SOCIETY.

ALDRED LECTURES.

NOMADIC MOVEMENTS IN ASIA.

By SIR E. DENISON ROSS, C.I.E., PH.D.,
Director of the School of Oriental Studies,
and Professor of Persian, University of London.

LECTURE I.—THE ARABS.

(Delivered April 22nd, 1929).

The four nomadic movements which form the subject of these lectures extend over a period of roughly 1,000 years. The first is the sudden exodus in the VII Century of the manhood of Arabia from their deserts and their rare towns into the lands of the Byzantine Emperors, and of the Chosroes of Persia. The second movement is that of the Turks, who, in the VIII Century, began

to migrate in a westerly direction from their habitats in Mongolia and Northern China. The third movement, namely, the penetration of Middle Asia by the Seljuks in the XI century, is, of course, only a corollary to the second: while the fourth, the most extensive of all, is that of the Mongolians under Chingiz Khan and his sons and grandsons in the XIII century. The period of time which elapsed between the exodus of the Arabs and the Mongolian invasion of Asia and Europe, of course, witnessed many other big movements of armies in Asia, but none of these can, I take it, be characterised as migrations of peoples: for these expeditions usually returned by the way they had come, whereas the Arabs, the Turks, and the Mongols established themselves as far as they were able wherever they penetrated by conquest, and had *no thought of returning to their original homes*. The Arabs and the Mongols, it is true, remained in close touch with their mother countries as long as they were able, but the early Turks and the Seljuks as it were carried their homes with them in a wider sense than the purely nomadic. If we consider the conquests of later Turks, such as those of Mahmud of Ghazna, in the X-XI century, of Muhammad the Khwarazm Shah in the XII, or of Tamerlane in XIV-XV, we shall notice that, although they resulted in the temporary establishment of vast empires, they were rather in the nature of military exploits by organised troops than of nomadic migrations, and that these leaders invariably returned to their headquarters at the termination of a successful campaign.

The case of the conquest of Upper India by the Mughals under the Emperor Babur, himself a Turk, offers peculiar features: for here we find a conqueror with an organised force setting up a new kingdom in a foreign land—a land inhabited mostly by Infidels—and founding a dynasty which became essentially Indian. There is no question of a Turkish Court at Delhi or of Turkish settlements in Hindustan. The Turkish troops under Babur seem to have left no more mark on the population of the Panjab than those under Mahmud of Ghazna (who invaded India no less than 14 times) or of Tamerlane who raided Delhi. It is in view of such considerations as these that I would claim a distinct place in history for the four movements which form the subject of my lectures.

There is in these lectures what I may call a quite unintentional unity of action, seeing that the Arabs encounter the Turks: that from these Turks spring the Seljuks: that the downfall of the Seljuks facilitated the invasion of Persia by the Mongols.

It is interesting to picture to ourselves the immediate effects of such wholesale invasions as we are now considering, in contradistinction to the passage through the country of a military invader.

As an example, we may take it that the occupation of N.W. France by the Norsemen was an immigration, whereas the conquest of England by the descendants of these Norsemen was a military invasion. One part of France became Norman and has remained so ever since: no part of England became Norman any more than India under British rule becomes English.

• THE EXODUS OF THE ARABS.

In order to give you a picture of this great exodus of the Arabs, I fear I cannot avoid referring at some length to the career of the Prophet Muhammad and to the foundation of Islam as a religion, and this will necessitate the repetition of many incidents with which most of you are, I am sure, already familiar.

For, in order to understand the true significance of the Arab invasion, we must realise what it was that led to the creation of a united nation in arms out of the unpromising material offered by the scattered Bedouins of the desert, whose only common bond was a vague fetichism. The Bedouin also had the tie of kinship which attached him to one or other of the great desert tribes: but his main characteristic was his love of independence. It is difficult for those who have not seen the lonely Arab in his desert to picture what this independence means. We are so apt to think of the Bedouins in terms of encampments, of large tribes wandering about with their flocks and tents in search of pasture or water. This picture has been made more familiar in recent times, thanks to the cinema and its ridiculous idealising of the *sheikh*.

Arabia, as we know her to-day, has no rivers, and her towns are few and far between. Three-quarters of her natural frontier is formed by the sea-coast. The rest of her frontier, extending from Akaba to the confines of Mesopotamia, is in desert land. In remote times, Arabia, according to the geologists, presented a very different picture and possessed streams and consequently pasturage. But, as has so often happened and as still happens to-day in countries where sand is prevalent, the desert has constantly eaten up the sown and finally dried up the rivers. This process of desiccation it was that led in the past to the migration of the inhabitants of Arabia, who were of Semitic stock, northwards into Syria, Palestine, Mesopotamia, and Babylonia. And thus probably originated those great cultural nations, the Assyrians, the Babylonians, the Arameans, the Syrians, and the Jews, who left behind them so great a heritage of literature and art.

I do not think either geologists or historians are prepared to give a date for these migrations, which did not probably all take place at one time. But it would seem that by the end of the sixth century the inhabitants of the Arabian peninsula had again so greatly increased, and the resources had again so greatly decreased, that the Semitic people—who now called themselves Arabs—were beginning to move northward, forming the Arab population of Syria, which under the Byzantine Emperors accepted Christianity.

We must not forget the close connection that exists between the character of the Arabs and the physical conditions of their land and of the Arabian desert in particular.

For us who have always lived in temperate regions, where the climate is mild and victuals are cheap and abundant, and where life is easy and secure, it is difficult fully to appreciate what a man's life is like in a country where

for more than eight months of the year the heat is asphyxiating by day and where in the winter the cold is intense by night, food ~~is~~ scarce and water a precious rarity, and any form of government is totally lacking, so that the life of every individual is in constant danger, either from nature or from man.

Only he who has journeyed in the desert can understand the terrors, the dangers and the suffering which these cruel solitudes impose on mankind, solitudes in which to go astray means certain death from thirst. Mere words cannot but fail in an attempt to describe the desert with its fearful summer heats, its immense stretches of burning sand, its rocky hills and plains, brought to a white heat by the implacable sun, where in summer every inch of ground burns so that it is almost unendurable to the human touch.

Of course there have always been among the Arabs townsmen and dwellers in the oases whose lives in general were very much like those of any other settled population in the East. But it is the life of the Bedouin nomad that offers us such a strange picture—I do not think it is commonly realised that the desert is largely peopled by small groups of wandering families, with small mixed flocks, who have *no home* to go to at any time, and who many of them never sleep under a tent. And in the desert the cold is at certain seasons as severe as the heat of the sun in the summer.

The wonder is that any race should have been found which was willing to endure all the hardships involved by such a life: and that the causes which led to the emigration of the other Semitic peoples did not compel this branch also to abandon Arabia when this once smiling and fertile land began to dry up.

In any case the Arabian Bedouin of the time of the Prophet knew of no other life and no other conditions than those of the desert: and long generations before them had learnt to resign themselves to what they considered the inevitable, and had developed those peculiar characteristics which fitted them to this strange and apparently aimless life. Though the Arab of those days was illiterate he had one element of culture strongly developed, namely, his love of poetry, and among them no man enjoyed such high prestige as a recognised poet, whose glory redounded to the honour of the whole tribe to which he belonged.

With the rise of Islam this gift gradually disappears—partly no doubt because Muhammad had a special dislike for poets—and although the Arabs quickly took to learning and letters after they had been brought into contact with the cultured nations they had conquered, there was no survival of real Bedouin poetry—only artificial imitations quite lacking in inspiration. The designation Arab as applied by us to-day to Literature and Art—except for this Bedouin poetry—does not mean the Arabian, but the product of that merging of the descendants of the early Bedouin invaders with the cultured races of the Near East and Middle East.

Let me now pass to a rapid survey of the rise of this new religion.

At the beginning of the seventh century the Yemen and part of the Hadramaut

were in the possession of the Persians, while the Syrian frontier was ruled over by the Gassanids under the suzerainty of the Byzantine Emperor. The whole peninsula was inhabited by Arabs, but the Hejaz contained large Jewish colonies which had been driven out of Palestine. Some of the Arabs were Christian, but the majority were heathen. They believed in a supreme God called Allah, who had created and who ruled the world. He had no temples in his honour and no priests to serve him. Next to Allah came the jinns who had fixed habitations in stones, trees or statues. Each Arab tribe had its special jinn or jinns. Mecca was the principal religious centre of Arabia, and possessed an old temple called the Ka'ba—or Cube—round which the tribe of Kuraysh had built a city in the fifth century of our era. The Ka'ba did not belong to the Kuraysh but was the common Pantheon of many tribes and contained three hundred and sixty idols. The most sacred object it contained was the Black Stone, which is still venerated by the Muslims. Hence the importance of the city of Mecca and of the tribe of Kuraysh which had the guardianship of the Ka'ba. The Arabs had no belief in a future life, and their religion was little more than a degraded fetishism.

Early in the seventh century there suddenly appeared an Arab named Muhammad, of the tribe of Kuraysh, inspired with the idea of reducing the number of Arabian gods to one, and of compelling his fellow countrymen to recognise his mission as divine. The new prophet being a townsman and a merchant, whose business had taken him into foreign countries, had often had opportunities of meeting Jews, Christians and Zoroastrians. Islam owed much of its success to the fact that so large a part of its doctrines was derived from these three great religions. The Prophet is instructed by God to say "I am no apostle of new doctrines, and I do not know what will happen to me or you. I follow naught save what has been revealed to me. For I am only a public admonisher."

The pagan Arabs had no "book" and very few monuments. Other nationals with whom Muhammad came in contact had a "book" and temples, but they had no idols. It is possible that Muhammad, impressed by the feeling that in these respects the Arabs were inferior to their neighbours and that idols were undignified, determined to provide his fellow countrymen with a "book" of their own and to exterminate all the gods but one. But in order to justify the preaching of a new religion he must prove its superiority to all others and try also to convert to his way of thinking the Jews and Christians. He was determined to make Islam the one religion of the Arabian Peninsula. He was, however, unable to satisfy either the Jews or the Christians, and thus one of his first objects was to turn the Jews out of Arabia. In connection with his relations with the Jews there is an infallible way of remembering the relative positions of Mecca and Medina. In the first instance, the Prophet instructed his followers to turn towards Jerusalem when saying their prayers. When he quarrelled with the Jews he reversed the order, and told the Muslims

to turn towards Mecca. For the people of Medina this meant *exactly the opposite direction*. His feelings against the Christians as such were no doubt somewhat modified by the fact that the Christian King of Ethiopia gave sanctuary to many of his persecuted followers who had fled across the Red Sea. This same circumstance may possibly account for the fact that Abyssinia was never invaded by the Arabs.

Muhammad, the son of 'Abdallah, the son of 'Abd-al-Muttalib, the son of Hāshim, the son of 'Abd Manāf, is said to have been born in A.D. 571. Of his early life down to the age of forty we know very little. At the age of twenty-four he married Khadija, widow of a rich merchant in whose service he had made caravan journeys into Syria and South Arabia. By this marriage Muhammad had six children, of whom we need only mention the youngest daughter Fātima. After the death of Khadija he married a young girl called 'Ayesha, the daughter of Abu Bakr.

About the year A.D. 610 Muhammad, who was given to solitary wanderings, one day had a dream in which it seemed to him that someone said to him: "Recite in the name of thy Lord who created man—and teaches man by the pen what he does not know." Muhammad was deeply impressed by this dream, which may be regarded as the beginning of his mission.

Thereafter he began to receive these dream messages with recurring frequency, and they were recorded or remembered by Muhammad as the Word of God delivered to him by the Angel Gabriel. Thus was created what came to be known as the Koran, or "the reading," which was only brought together after the Prophet's death. It should always be remembered that the Koran contains not the words of the Prophet, but the Words of God. All quotations begin: "God said—" not: "Muhammad said."

The whole of his family, including his adopted sons 'Ali and Zayd, and many of his intimate friends immediately believed that Muhammad had received a divine mission. The most important of these friends was Abu Bakr, a wealthy merchant who belonged to the tribe of Taym. The complete faith which this honourable man placed in Muhammad and his mission was not only an invaluable source of encouragement to Muhammad, but is a most important testimony to the genuineness of the Prophet's mission.

His uncle, Abu Tālib, became his chief supporter. Though only a poor man, he enjoyed the highest respect of all the Hāshimites, and whilst he lived no one would dare to attack Muhammad.

Not all the Kuraysh, however, were prepared to follow him, and the most notable opponent was another of his uncles, Abu Lahab, who was consequently condemned in the Koran to hell fire.

Another Kurayshid follower was won by his marriage with two of Muhammad's daughters, namely, 'Othman, of the family of Omayya. In all, the first band of the faithful are said to have numbered forty-three persons. Among these were several slaves, and mention may be made of an Ethiopian

named Bilāl, who, by reason of his loud voice, became the first *Muezzin* to call to prayer in Islam. The whole Muslim confession of faith is contained in the words: "*There is no Deity but Allah, and Muhammad is the Prophet of Allah.*"

By day the Prophet preached to the people, and by night he received revelations, which often had bearing on current events. Muhammad knew no half measures; and the name Muslim, applied to believers, is derived from the word *Islam*, which means "total submission to the will of God."

The public feeling against the new religion often took an active form, and the Muslims were mocked and persecuted. Indeed, they were soon obliged to hold their meetings in a private house. But the turning point in these first years of the mission was the conversion of 'Omar, the son of Khattāb, who had hitherto been one of the strongest opponents of Islam. This young man of twenty-six already commanded so much respect among his townsmen for his bravery and decision of character that from the day of his acceptance of Islam the Faithful were able to perform their prayers in public. The importance of the role played by 'Omar in the history of Islam cannot be overrated. It was he who spurred the Prophet on to action, and encouraged him to undertake the conversion of all Arabia; and to resort to force of arms where peaceful methods failed. It was 'Omar, moreover, who initiated the invasion and conquest of the outer world by the Arabs.

Towards the end of A.D. 619 two great misfortunes befell the Prophet. Within a few weeks he lost first his faithful Khadija, to whom he had been married for twenty-four years, and then his uncle and staunch defender Abu Tālib, who enjoyed such respect in Mekka that no one dared to attack his nephew. On the death of Abu Tālib, Muhammad's position in Mekka became one of such grave danger that he was, we are told, afraid to leave his own house. He was peremptorily ordered to give up his public preaching, and to cease from attacking the idolatry of his compatriots. In the meantime, however, during the annual pilgrimage which brought Arabs from far and near to Mekka, he had succeeded in converting a number of pilgrims to the New Faith, and notably some inhabitants of the town of Yathrib. With them he formed a secret alliance in A.D. 620; but no sooner was it noised abroad that he had thus betrayed his own home and his tribe, than further residence in Mekka became impossible for him. He therefore resolved to migrate to Yathrib and seek the protection of its inhabitants; but the number of converts he had succeeded in making during the pilgrimage was not sufficient to guarantee the support of the whole tribe. In A.D. 622 a secret meeting was held during the last days of the pilgrimage, between the Muslims of Mekka and the envoys from Yathrib; as a result of which the former migrated to the latter city, where they were received with open arms by the local converts. The last to leave Mekka were the Prophet himself, Abu Bakr and 'Ali: it is from this event—known as the *Hijra*, i.e., the

migration or flight of the Prophet—that the Muhammadan era dates. The town of Yathrib, to which Muhammad fled, now received the name of al-Medīna, which means “the city *par excellence*.” He found Medina ready to receive him, and it remained his headquarters for the next ten years; for he did not capture Mekka until just before his death.

During these ten years the Prophet was constantly engaged in warfare and in bringing the people of Arabia to obedience. He was determined to make the new religion the religion of the whole peninsula, and by the time of his death, in 632, he had practically achieved his purpose.

When Islam was carried outside Arabia as an established religion, the Muslims were more tolerant, and, apart from the risk of eternal damnation, the conquered peoples had only to choose between Islam and the payment of an annual fine.

Whatever opinions we may hold regarding the message of the Arabian prophet, we may rest assured that Muhammad always had complete faith in himself. It would be difficult to imagine any man starting on such a career as his at the age of forty for other than a spiritual motive. Whether Muhammad at the outset conceived the idea of making Islam a universal religion—and texts have been quoted from the Koran to show that he did—is still a matter of debate, but he certainly could not have entertained any thoughts of temporal leadership, still less of sovereignty over all the Arabs. During the ten years of the Prophet's life that remained to him after his flight to Medina he took part in no less than twenty-seven battles and organised forty-seven expeditions. It may be imagined, therefore, that he cannot have had much inclination to think of converting the outside world. Tradition speaks of letters addressed by Muhammad to the Byzantine Emperor and to the Chosroe of Persia, demanding their acceptance of the new faith, and a force of some size for a punitive expedition over the Syrian frontier had been collected in Medina just before the Prophet's death; but beyond this there is nothing recorded which points to a determined propaganda outside Arabia. Muhammad gained his lordship over the Arabs by force, and while his devoted generals were wielding the sword on his behalf, he himself was laying the foundations of the faith which, though it at first found so little favour in Arabia, was ultimately to be accepted by peaceful preaching in so many countries outside the Prophet's own land. We may take it that the Arabs as a whole felt very little drawn towards either dogmatic beliefs or ritual practices. This indifference was largely responsible for the intransigent form given by the Prophet to the creed he preached. But propaganda in the truest sense only makes its appearance in Islam in connection with the parties and sects that arose among the Muslims; factions which, though bearing a religious semblance, were purely political in aim, such as propaganda of the 'Abbasids in Khurasan, of the Fātimids in Egypt, and of the Ismailis in Persia. Behind most of these movements,

notably the **great** schism between the Sunnis and the Shi'as, lie the disputed claims of inheritance. It is interesting to recall that no such questions were at the back of Christian schisms, which were all dogmatic. Whereas these arose on questions which had reference to the preaching of Jesus Christ, Islamic schisms nearly all related to the question of succession to the Caliphate, on which Muhammad has made no pronouncement at all.

The hold of the new faith over the Arabs was of the slightest, and it is highly probably that if chance had not at an early stage filled the Muslims with a desire for foreign conquest, the whole of Arabia would have reverted to its original state. For the Arabs above all love independence, and the Bedouin resents all forms of control and authority beyond that of his tribal chief, and that sits lightly enough.

It was the civil war necessary for the conversion of the Arabs which gave the warlike character to Islam ; and it was the successes of Muslim generals like Khālid ibn Walid which tempted the faithful to try issues with foreign nations.

The battles in which the true believers were during ten years so constantly engaged against their fellow countrymen, were never on a very large scale—but they did suffice to make the fame of a number of capable commanders, and to give the Arabs as a whole more experience in warfare than they were in the habit of deriving from their inter-tribal feuds. We can imagine that they now wanted to turn to advantage the experience they had thus gained and try issues with the Arabs over their frontiers. The very first movement of this kind was a raid led by certain hot-headed men into Transjordan, where they came into collision with Byzantine troops by whom they were utterly routed at Mūta. It is more than likely that the Prophet would immediately have followed up this defeat by an expedition of revenge into Syria, but he was at that moment engaged in the important task of capturing the town of Mekka. When in 631 he at last achieved this he assembled a huge army and set out towards Syria to avenge the slaughter at Mūta. He did not accompany the expedition very far as his presence was needed in Mekka, and in the following year he died and the expedition was abandoned. Muhammad died without appointing a successor ; and this may be accounted for by the fact that he did not realise that he had founded not only a new religion but also an empire ; that he was not only the Prophet of God and Islam, but had also become virtual king of Arabia. There was much discussion after his death regarding a successor, and finally his old and trusted friend Abu Bakr was appointed Khalifa or Caliph. He **only survived** for two years, but in these two years he initiated the first stages of the conquest by the Arabs of the outer world. The first task which lay before Abu Bakr was suppressing the revolutions which followed the death of the Prophet. Three different pretenders arose in various parts of the Peninsula and laid claim to the Prophetic office, and it is noticeable that these rebellious leaders never posed as princes or kings, but only as rival

prophets. It was the courage and firmness of the aged Abu Bakr which saved Islam at this crisis. One Muslim historian writes :—" On the death of Muhammad it wanted but little and the Faithful had perished utterly. But the Lord strengthened the heart of Abu Bakr, and established us thereby in the resolve to give place not for one moment to the apostates ; giving answer to them but in these words : ' Submission, Exile, or the Sword.' "

In 633 when Abu Bakr had managed to bring back to the fold the recalcitrant Arabs, he was faced with the problem of a country full of trained men who were a positive menace to peace. As a solution for this difficult problem he decided to send thousands of these men over the northern frontiers with promises of loot such as they had never dreamt of. I do not think either he or anyone else then thought of conquest on an extensive scale ; it could hardly occur to them that they would so soon find themselves in Cairo and Khurasan. He dispatched two armies towards Iraq ; one of these armies under the famous Khālid is said to have numbered 20,000 men.

The first battle fought took place at Hafir and was known as the Battle of the Chains, because some of the Persian soldiers are said to have been bound together with chains to prevent their running away. Khālid, who began the engagement by slaying the Persian satrap in single combat, gained a decisive victory over the enemy and was able to send vast booty to Medina.

At this time Bedouins were fighting on both sides and the famous tribe of Bakr was about equally distributed. The intense cruelty of Khālid towards the prisoners aroused bitter feelings on the part of the non-Muslim Arabs. Otherwise it might have been possible for him to advance at once against the Persian capital Ctesiphon. He, however, first directed his march towards Hira, on the Euphrates, which capitulated, and here was concluded the first treaty between the Arabs and a foreign power. Hira, in which Khālid remained for one year, was the first foreign town of importance to be occupied by the Muslims.

A third army meantime had been despatched to Syria under a leader also named Khālid, who, though he had better troops, could not be compared with his namesake in generalship. In his first encounter with the Byzantines Khālid fled and Abu Bakr now despatched a strong force in four detachments numbering, we are told, between 30,000 and 40,000 men. They concentrated at a spot on the river Yarmuk, which falls into the Jordan below the lake of Gallilee. For some time desultory fighting occurred, but the four leaders were unable to come to an agreement on a joint attack, and feeling that what was needed in this great emergency was a unity of command, Abu Bakr recalled the other Khālid from Iraq and placed him in command of the Syrian army. In the battle which ensued the Byzantines were totally defeated and the fate of Syria was sealed. The Muslims are said to have lost three thousand men, while the Byzantine losses are estimated at over a hundred thousand. This large figure is to be mainly attributed to the fact that the Greeks were hurled over a yawning gulf which lay immediately in their rear

In 634 Abu Bakr died and was succeeded by 'Omar, who had already played such an important part in the rise and progress of the new religion. In 635 Damascus fell. In the following year Heraclius abandoned Syria. In the great victory of Qadisiyya in 637 the Arabs drove the Persians out of all their western possessions and became masters of Iraq, including the then capital Ctesiphon, where the Persians offered stubborn resistance. Progress from now on was so rapid that within twelve years of the Prophet's death the Arabs, marching north, east and west, had acquired territory as large as Germany and Austro-Hungary before the war. Thus did the unlettered Bedouins, with no government and no discipline beyond the loyalty to their chiefs, conquer highly civilised peoples ruled by kings of ancient lineage and by a highly efficient bureaucracy.

It is not my object in this lecture to enumerate the battles won or the lands conquered by the Arabs in their triumphant progress East and West, but rather to help you to understand the political conditions and other circumstances which brought about this sudden exodus from Arabia at the beginning of the seventh century, and rendered possible their victories. The fundamental causes of this movement may have been, as I have said, partly economic; they were certainly in a large measure political; and ostensibly they were wholly religious. But although the Muslims had a *slogan* or war-cry, one cannot help feeling it was their love of fighting and of loot that was their strongest impetus: for the clearly-defined conditions of conquests which they adopted go to show that their main objective was the occupation of fresh territory.

One can well imagine the astonishment of the Byzantines, the Persians and the rest when they discovered that these unlettered men in addition to their swords and spears had a new religion which was made their excuse for invading the world. Surely no other victorious army in history has ever insisted on spreading a new religion. And surely no other religion has ever been first preached at home and abroad at the point of the sword.

It has been suggested by some writers that it was the friendly attitude of the Semitic peoples in Syria and Iraq which changed the original plan of using the trained men of Arabia for simple raids across the frontier into one of conquest. "Among the shrewd companions of the Prophet at Medina, the idea speedily gained ground that instead of the precarious adventure of such raids from which only those engaged in them would benefit, and which would only leave destruction in its train—the friendly attitude of the indigenous population, who had no reason to love their rulers, whether Byzantine or Persian, now made it possible to turn the ephemeral gains of an expedition into a permanent and secure source of revenue to the newly-founded state of Islam. It was therefore these Semitic subjects of Christian and Zoroastrian rulers who really turned the Arab raiders into conquerors—and not only did they offer no resistance except under compulsion—but they rendered practical

assistance to the Muslims by acting as spies and by offering their services in the administration of the new state."

Our only sources of information are those of the Arabs themselves, and it is quite natural that their chronicles should maintain a discreet silence on any factors in the story which tended to diminish the glories of the conquest. •

We at any rate know that on the whole very little opposition was encountered while the expeditions of the Muslims were confined to Semitic lands. Only Caesarea in Palestine and Ctesiphon in Iraq offered really strong resistance. The task of the invaders became more difficult when they came into conflict with non-Semitic populations.

In view of the comparatively sparse populations of the Peninsula the number of the Moslem troops engaged in these early conquests cannot have been very large: but new recruits would be constantly arriving, and after a quarter of a century had elapsed from their first exodus, there were doubtless thousands of young Muslims ready to take up arms whose mothers were of non-Arab origin.

Another important factor of the success of the Muslims was the good treatment meted out to all who submitted without resistance.

The conditions of conquest were clearly defined. Where the population submitted without any show of opposition, they were allowed to retain their own religion and to continue in possession of their lands: all that was required of them was the payment of a capitation tax which was considered to be the price they paid for the protection they received from the conqueror.

Where, however, armed resistance was offered and force had to be employed the Muslims claimed the right to pillage the country, kill the men and make slaves of the women and children. Of course any one who wished to turn Muslim was at once admitted to the fold on pronouncing the simple formula of Islamic faith. According to the prescriptives of the second Caliph 'Omar every Muslim was a soldier of Islam who might at any moment be called upon to defend the faith, and was entitled to pay for services rendered.

The Muslims were forbidden to acquire land, and received payment either in money or in kind which was derived either from the tax on the conquered or from loot. The old division of the Arabs into tribes was still continued, with its concomitant internecine quarrels and its *vendettas*. The conquered peoples cultivated the soil, the Muslims lived on the produce and had no occupation but that of soldiers.

One can readily believe that the conditions of life in these new surroundings did not fail to have a demoralising effect on these Arabs of the desert, and that in the course of time those who settled in towns became luxurious and effeminate. Where the population becomes settled tribal solidarity and tribal loyalty tends to disappear.

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4010.

VOL. LXXVII.

FRIDAY, SEPTEMBER 27th, 1929.

*All communications for the Society should be addressed to the Secretary, John Street,
Adelphi, W.C. (2)*

NOTICE.

COMPETITION OF INDUSTRIAL DESIGNS.

LOCAL EXHIBITIONS

The Exhibition of industrial designs at the Imperial Institute, which was viewed by a large number of visitors during the month of August, closed on September 1st. Arrangements were made this year, as on several occasions in previous years, for holding local exhibitions of particular sections of the designs in provincial centres after the termination of the Exhibition in London. Two such local exhibitions were arranged this year—an exhibition of the china and earthenware designs and exhibits from September 16th to 30th at the Burslem School of Art, and an exhibition of the glass designs from September 23rd to 25th at the Wordsley School of Art.

PROCEEDINGS OF THE SOCIETY.

ALDRED LECTURES.

- - -

NOMADIC MOVEMENTS IN ASIA

By SIR E. DENISON ROSS, C.I.E., PH.D.,

Director of the School of Oriental Studies,
and Professor of Persian, University of London.

LECTURE II THE TURKS

(*Delivered April 29th, 1929.*)

I should like to confess to you that when I undertook to lecture on the early Turks as a part of this course I did not realise, in spite of the amount of time I have devoted to this subject, how difficult a task I had set myself.

Scholars have dealt at enormous length with such details as the identification of the names of the tribes and the towns, and are for ever propounding new theories, but no one it seems has ever had either the time or the courage to piece together the puzzle. In dealing with the Arabs, the Seljuks and the Mongols, one has a due series of historical records to go upon and positive dates and topography, but in dealing with these Turks, everything is more or less in the air. When we consider how many big problems in regard to race origin still remain to be solved—such as the original home of the Aryans, of the Sumerians, or of the Georgians—it is interesting to find a nation which one can trace step by step from their original homes to the furthest limits of their migrations as we can trace the Turks from Mongolia to the Balkans, but our more precise knowledge of the Turks dates from comparatively recent times.

Writing of the Tartars in 1820, the famous French Orientalist, Rémusat, remarks:—

“The origin of these nations is still very obscure. It is impossible as yet to say from how many races they sprang, and what territories they originally inhabited, or to determine with any certainty what circumstances led to their emigrations. In the absence of data, due largely to the fact that no one has taken the trouble to collect and sift what does exist, it is not surprising that the most contradictory theories should have been advanced regarding the antiquities of Tartary.”

You must remember Rémusat had access to the Chinese authorities, which are plentiful, as the history of each dynasty had a special chapter on their foreign neighbours, quite apart from the incidental dealings they had with them. During the last thirty years, however, Chinese studies have undergone a profound transformation, and the discoveries of archaeologists in Central Asia have set at rest some of the most vexed questions regarding the early inhabitants of Tartary. Among these discoveries nothing is more arresting than the decipherment of the Turkish inscriptions of Northern Mongolia, which, taken together with the material found in the Chinese annals, give us a vivid picture of the Turkish race in the sixth, seventh and eighth centuries after they had left their settlements on the Orkhon and Selinga Rivers.

The westward movement of the Turks from the steppes of Northern Mongolia constitutes the first stage in history of the penetration by various branches of this family into Central and Near Asia and into Europe, including the Pechinegs, the Comans, the Tartars of the Volga and of the Crimea, whose history forms an interesting subject of study and one that has received little attention except on the part of Turkologists.

In my present lecture I wish not only to give you some idea of the origin of the Turkish people, but also to trace the beginning of their westward movements down to the period, namely, the middle of the seventh century,

when the Arabs, arriving from the opposite direction, had reached the Oxus country, and found themselves for the first time face to face with a Turkish power. It was not till the middle of the eleventh century that the Turks began to spread in large numbers over middle Asia (and this will form the subject of my next lecture), and it was the Arabs who barred the way to further westward progress during the intervening period, just as it was the Turks and the Chinese who prevented the Arabs spreading into Eastern Turkestan. For the rise and progress of the Turks down to the eighth century we rely upon Chinese historians: and for their subsequent history it is mainly to the annals of the Muslims that we must turn.

Central Asia, which was known to our forefathers by the convenient name of High Tartary, is surrounded on all sides by almost impassable mountains. There are only two natural exits, the one to the north-west in Zungaria, the other in the south-east. It was this latter exit that the earliest nomad and pastoral people of this inhospitable country usually selected as giving them, in a few days' march, easy access to the rich and fertile plains of China. This circumstance explains how it was that the great migration of Central Asian hordes did not take place until a comparatively recent date in the history of mankind: that is to say, in the third century B.C., when the Chinese, under an Emperor of the Ch'in dynasty, tiring of the incessant incursions of the tribesmen on their northern frontiers, of which their early records are full, set about the completion of the Great Wall by joining into one continuous wall the various barriers which had been from time to time set up by the barons of the northern marches. It was the construction of this formidable obstacle by the Chinese that led to the great Western migrations from Mongolia and Eastern Turkestan, and hastened the downfall of the Abbasid Caliphate.

With regard to the country in which we first hear of these nomadic races, I feel I cannot do better than read you a few extracts from a paper read recently before the Royal Geographical Society by Mr. Lattimore.¹

"It has been roughly estimated that about a fourth of Mongolia is either utter desert, or so arid as to invite the occupation of only the poorest nomads. Not all of the remaining three-fourths are arid enough to compel nomadic pastoral life, without the alternative of settled occupation. Every important mountain range appears to be a centre of good climatic conditions, including a regular water supply, from which the climatic lines radiate outward and downward, through arable land and steppe country to sterile desert. This, however, is a physical structure which makes the mountains centres on which nomadic life converges, rather than barriers separating one climatic region from another. The tendency to a nomadic life, therefore, has always dominated the tendency of society to attach itself to particular localities and develop the culture of fixed communities. Well-favoured regions exist in Mongolia where agriculture

¹ See *The Geographical Journal*, December, 1928.

is quite possible. Still more favoured regions are to be found, with abundant forests, good arable land, and easily worked mineral deposits, where it might be expected that men would readily turn from the nomadic life to one of permanent occupation. Historically, however, it has always been difficult for a minority to settle in such regions, because they lie open to regions in which a conversion from the nomadic to the agricultural life is not likely, and the accumulated wealth of settled inhabitants would provoke raids from the wandering tribes.

"It is evident that there have been attempts in Mongolia to break away from the nomadic tradition. In the fertile part of northern Mongolia, where numerous lakes and rivers drain toward Siberia, many tumuli and stone monuments indicate that the country was once held by the Uighurs, who appear to have been the central stock of all the Turkish tribes, and the first of the Turks to adapt themselves to agriculture and permanent habitations. The Uighurs, apparently, first showed a tendency to settle down while in this region, but they were dislodged by the tribes whose modern representatives are the Qazaqs, and after migrations which took them first westward, in the direction of Chuguchak or perhaps farther, they pitched at last on the northern flanks of the Tien Shan, which form the southern rim of Zungaria. There they speedily adopted agriculture and rose to a high degree of culture. Their capital is supposed to have been near the modern Urumchi, and they even spread beyond the Tien Shan to Turfan, which is in the true zone of oasis-culture.

"The first migration from Mongolia of tidal proportions, that of the Hun tribes, appears to have taken place about the dawn of our own era, at a period when the power of the Chinese was also in the ascendant, and the Great Wall frontier was being asserted. The power of resistance which it represented gave the migration a set that took it to the north-west, away from China and the settled country and into the Russian steppes. There is ample evidence in history to show that this initial westward drift, though confirmed by subsequent migrations, was concurrent with periodic backwashes that affected China and northern Chinese Turkistan. Strong Hun tribes were established for a long time in the Barkol Tagh, dominating the obvious trade-route approach from Kansu province to Qomul (Hami) Turfan and Urumchi, and forcing the Chinese to work out the more difficult "silk road," the classical route through the wastes of Lop Nor into southern Chinese Turkestan."

The centre of interest for us lies, in the first place, between Lake Baikal and the Northern frontiers of China. The position of Lake Baikal is easily pictured if we remember that the Trans-Siberian Railway on its way from Vladivostok to Moscow skirts its Southern shores. It is from the country watered by the rivers which run into Lake Baikal from South to North that the ancestors of the Huns, the Turks and the Mongols migrated, and it is in this country that they established their capitals: notably the towns of Karakorum and Kara Balgassun. 'It includes Mongolia and the Great Desert of Gobi. It is bordered

on the North by Siberia, on the East by Manchuria, on the South by the Chinese provinces of Shen-si and Shan-si and on the West by Zungaria and the Altai and Chinese Turkestan and the Tien-Shan.

The only practicable land routes between Northern China and the West in ancient times were ;

1. The route through Chinese Turkestan, which did not touch Mongolia at all and lay South of the Tien-Shan, and

2. The route through Central Northern and Western Mongolia and thence North of the Tien-Shan.

These were the alternative routes used for the silk trade

The term Chinese Turkestan is of course merely descriptive, for at the time of the first appearance of the Turks this country was inhabited by Indo-Germanian peoples, including the Iranian Sakas who lived between Kashghar and Khotan and the Ephthalites, who were established in the 5th century in Soghdiana whence they had driven out the Yüeh-chi or Kushans.

The whole country which the Turks began to occupy in the sixth century, which we now call Eastern Turkestan was inhabited by people of Indo-Germanic stock, mostly Iranian. South of Lob-nor there were Indians, North of Lob-nor, probably as far East as Hami, were Iranian Soghdians whose influence stretched as far West as the Oxus ; between Kucha and Turfan there dwelt a strange people called the Tokharians, whose Indo-Germanic dialect seems to belong to the European group ; they were probably the descendants of the Yüeh-chi who, having driven the Sakas out of the valley of Ili, founded in the fifth century a powerful kingdom. Both the Sakas and the Yüeh-chi had adopted Buddhism, as did later on many of the Turkish tribes.

According to the Chinese, these nomads were divided from the earliest times into two main groups, namely, the Hsiung-nu and the Tung-hu. The Hsiung-nu were the ancestors of the Mongols and the Turks, and the Tung-hu of the Tunguz races, the ancestors of the Manchus and the Koreans. The oldest Chinese traditions tell us that, before the time of Yao and Shun, that is about 2500 B.C., while the ancestors of the Chinese were establishing themselves in Shensi and Shansi, they were brought into frequent contact with the wild nomadic people of the North and West. Their general name for these neighbours was Jung or Shan Jung ; this name occurs both in the *Shih Ching* and in the *Shu Ching*. They also spoke of them as Hin Yung and Hun Yok. These names gave way later to the familiar name Hsiung-nu, which was current down to the sixth century A.D. All the names seem to point to an original name like Hsiun or Hun, which we find again in the Sanskrit Huna, and our word Hun.

But, though these two races, the Tung-hu and the Hsiung-nu, were sharply distinguished from the Chinese at the time referred to, there can be no doubt that at an earlier stage all three had to a great extent intermingled. The very circumstance of the constant raids in which the women as well as the flocks were carried off by the various peoples in turn, would imply much mixture

of blood ; and the marriage of a chief to the daughter of a rival chief is often recorded in Chinese history. Moreover, different as are the old Turkish, the Tunguz and Mongolian languages, their resemblances and their mutual borrowing of words point to a close and constant intercourse between these peoples.

It is probable that when the Hsuing-nu first came into contact with the Chinese they were no longer a purely Turkish people, so that, if we are to admit that the Huns who invaded Europe in the fourth century A.D. are to be identified with the Hsiung-nu it can hardly be claimed that they represent only one particular race. Their original habitat at the date of this contact must have extended far South into China. It was in the Southern portion of the present provinces of Shansi and Shensi that the first conflicts of the Chinese with the Hsuing-nu took place. It is probable that the Chinese were in most cases the aggressors. In the course of later history the Hsuing-nu were continually driven more and more to the north of the Gobi desert. In A.D. 220 the Hsuing-nu were conquered by Tunguzian Hsien-pi, who remained masters of High Tartary for about a hundred years. Owing to the rise of other powers in Turkestan, the Hsuing-nu power was finally brought so low that for several centuries they seem to disappear as a separate people. They are not heard of again until one branch of them appears in the sixth century as T'u-chüeh in the Koko-nor region.

The earliest monuments hitherto discovered of the Old-Turkish language are the inscriptions found by Yadrintsef on the Yenissei River in 1890. These inscriptions belong to the Kirghiz and not to the Turks proper, though they are written in a language and a runic script closely resembling those employed in the famous monoliths discovered later on the Orkhon River. The Orkhon inscriptions, thanks to the researches of Thomsen of Copenhagen and Radloff of Petrograd, have brought to life again the earliest Turks known to us in history ; for they give us a first-hand account of these people written by themselves. These inscriptions are engraved on two monoliths situated about a mile apart in the desert country near Lake Kosho-Tsaidam to the west of the Orkhon River. They are about fifty miles north of the old site of the town of Karakorum, which was the capital of the Northern Turks, and twenty miles to the north-west of Kara-Balgassun, the ancient capital of the Uighurs, where Turkish inscriptions have also been found.

The first of these monoliths bears on one side a long Turkish inscription engraved in honour of a certain Kutlugh Khan by his brother Bilgä Khan, and on the other some beautifully executed Chinese inscriptions bearing the date A.D. 732, the 20th of K'ai-Yüan of the T'ang dynasty. The second monolith, which bears the date A.D. 735, was erected in memory of Bilgä Khan who had died in the previous year. It likewise bears a Chinese inscription ; and we learn that, on the occasion of the death of both these princes, the ruling T'ang Emperor sent special missions of condolence to the Turks and ordered inscriptions to be erected in their honour.

The contents of these great inscriptions fall into three distinct parts :--

1. General, containing a sketch of the history of the Turkish empire from its foundation down to the reign of Bilgä Khan.

2. A special detailed account of the doings of Kültaghin and Bilgä Khan from the beginning of their reigns till their deaths.

3. An epilogue describing the services rendered by Bilgä Khan and his people.

The history contained in the general portion deals with the foundation of the old Turkish kingdom in the middle of the sixth century down to its overthrow by the Chinese in 630 A.D. It next deals with the 50 years during which the Turks were struggling to release themselves from the Chinese yoke. Then comes the short description of the restoration of the Turkish kingdom under Kutlugh Khan, the father of Bilgä Khan, and the history of Mé-chüe, the uncle of Bilgä Khan, whose career begins at this time. They conducted battles against the Turgesh in the west, and against the Kirgiz whose Khan, Bars-beg, was killed, and to whom a *balbal** monument was set up. Finally we have the reigns of Bilgä Khan and Kültaghin with their wars against the Oghuz and the Chinese.

It may interest you to hear how these early Turks are described in the contemporary Chinese annals.

"The T'u-Chüeh wear their hair long and loose, throw the skirt of their garment to the left side, and live in felt tents. They wander from one place to another, settling down where they find water and grass. Their chief occupations are tending their flocks and hunting. They have little respect for old age, but show great admiration for a man in the prime of life. They are without any sense of honour and have no idea of law and justice, in which they resemble the Hsuing-nu.

Their functionaries are divided into 28 distinct classes, and all the offices are hereditary.

Their arms are bows and arrows, lances, sabres, swords and breast plates. They are skilled horsemen and archers. They wear belts ornamented with carved and embossed designs. Their flag staffs are surmounted with the head of a she-wolf in gold. The king's gentlemen in waiting are called *fou-li* (i.e., *Bürü*, a word meaning wolf).

When a man dies, his body is placed in his tent. Then his sons and nephews and relations of both sexes each kill a sheep and a horse, and spread them out in front of the tent as though offering sacrifice. They ride round the tent seven times uttering melancholy wails, and as they pass the door of the tent each one cuts his face with a knife, so that his blood mingles with his tears. When they have been round seven times they stop. Then they choose an auspicious day and burn the horse belonging to the deceased together with all his possessions. The ashes are gathered up, and the burial must take place

*A *balbal* is, it seems, a monument set up in commemoration of a defeated enemy.

at certain fixed times. If a man dies in spring or summer, he must not be buried until autumn has come and the leaves have fallen from the trees. If he dies in autumn or winter the burial must be postponed until spring when the trees and plants are in leaf. Then a grave is dug and the corpse buried, and on the day of the burial the relations offer sacrifices riding round on their horses and cutting their faces as on the day of death. After the burial, stones are placed over the tomb and a sort of monument erected, on which is painted a representation of the deceased and of the combats in which he has been engaged. The stones vary in number according to the number of his enemies the deceased has killed. If he has only killed one, one stone is placed on the grave; some, however, have as many as a hundred and a thousand.

After the death of a father, an elder brother or an uncle, the sons, the younger brother or the nephews marry their widows and sisters. Although the T'u-Chüeh wander from place to place, each one possesses a certain portion of land. The Khan lives permanently on the mountain of Tu-Chin. His tent faces east out of respect for the quarter in which the sun rises. They pay homage to demons and spirits and believe in magic. They glory in falling in battle, and would blush to die of illness."

The T'u-chüeh flourished from the middle of the sixth century to the middle of the eighth. The first allusion to the T'u-chüeh in the Chinese annals occurs in the year 545, when the western Wei Emperor sent an embassy to them; and in this connection we are told that originally they formed a small kingdom to the South-West of the Altai mountains. These T'u-Chüeh had migrated from the North, and in the middle of the fifth century had settled in the neighbourhood of Lake Kokonor, and were tributary to the Tunguzian Jüan-Jüan (Avars) under whom they lived in a state of subjection as workers in iron. Under their Khan, Tümen, they had, by the middle of the sixth century, attained to considerable power, and had begun to infest the western frontiers of the Wei emperor; and it was for this reason that the embassy was sent to them from the Chinese Court.

In 551 Tümen married a daughter of the Emperor T'ai-tsu, with whose aid the T'u-Chüeh defeated their former masters the Jüan-Jüan. Tümen thereupon adopted the Jüan-Jüan title of Ili-Khan. This is the earliest mention of the title Khan or Khaghan. His younger brother, Istämi Khan, who accompanied Tümen on all his expeditions, was the head of the section of hordes known as the Turks of the Ten Tribes; and it is from him that the Western T'u-chüeh traced their descent. Both these chiefs are mentioned in the Orkhon inscriptions. Tümen died in 552 and was eventually succeeded by his son Mokan, who in 554 finally routed the Jüan-Jüan, and the Turks thus became masters of all the country from Korea right up to the Caspian.

They now came into collision with the Ephthalites, or White Huns, with whom the Jüan-Jüan had concluded a treaty of peace, and who had been established since 450 in the rich country between the Yaxartes and the Oxus,

whence they had driven out the Yüeh-chi (Kushans or Indo-Scythians) The Ephthalites had been engaged in continual warfare with the Sassanian rulers of Persia. In 555 the Sassanian monarch requested and obtained from the Turkish Khan a Turkish princess in marriage ; and a year later he sent a letter to Mukan Khan asking him for aid against the Ephthalites. To this the Turkish Khan agreed, and the Ephthalites, caught between two powerful enemies, were finally defeated. The Turkish Khan, having established himself in Transoxiana, wrote a letter to the Persian King, Anushirwan, saying that the blood of their common enemies had reddened the waters of the Oxus

As a result the Ephthalite empire was divided between the Khan of the Turks and Anushirwan of Persia. Roughly speaking, the Oxus formed the dividing line

The Turkish language had not apparently come into its own at this date, for this letter, we are told, was written on satin and in Chinese. The Persian King had this letter translated by a priest in his employ and sent a reply written on paper in the Pehlevi or old Persian language.

The power of the Sassanian dynasty was already waning ; and the Turks, elated with their recent triumphs, were not slow to take advantage of the good bargain they had struck. Within a short time they had practically annexed all the countries which had been included in the later Kushan Empire, for no sooner had the Turks become their neighbours than they showed themselves to be the worst enemies of the Sassanians. They did all they could to encourage the Byzantines to attack the Persians. In A.D. 568 the first Turkish embassy was sent to the Byzantine Emperor ; and in the following year a mission arrived at the camp of the Khan (called by the Greeks *Dilribul*, in part a corruption of the Turkish title *Yabghu*) from the Emperor Justin II. The object of this mission was to secure a direct route to Europe of the raw silk, and thus to avoid the obstacles put in the way by the Persians, who had, owing to their geographical position, created a monopoly of the Chinese silk trade. Although Justinian had managed to secure through certain missionaries a number of silk-worm eggs and had thus established the manufacture of silk in the Greek empire (552), the large and increasing demand for raw silk could not be in this way satisfied and the importation through Persia involving heavy duty still continued. It was during the reign of Justinian that the Turks reached the height of their power ; and with their capital near the modern Urumtsi, in the neighbourhood of Lake Balkash they controlled practically the whole country from Eastern Turkestan to the Chinese frontier ; and thus all Chinese merchandise was obliged to pass through their territory. There were three routes, all of which began by the crossing of the Gobi desert to Hami :—The main route lay through Soghdiana, that is, the country round Samarkand ; but when the Turks became master of this country the Persians became anxious lest the Turkish armies might follow in the steps of the silk caravans, and they therefore forbade the Persians to buy silk from the Soghdians. It was at

the request of these local merchants that the Turkish Governor sent an embassy to Persia to request the withdrawal of this ban. We are told that the Persian king not only refused this request, but actually burnt in the presence of the envoys the silk they had brought with them.

The Soghdians were therefore compelled to find some other outlet for their silks, and it was at their suggestion that the Khan of the Turks entered into friendly relations with the Byzantines. The Emperor Justin II received them in the most friendly way and sent a return embassy to confirm his treaty with the Turks (568-569). Thereafter the caravans were directed to the north, but the exact route is not known.

The trade through Transoxania was only resumed after the fall of the T'u-chüeh in the first half of the 7th century.

In 630 the Northern T'u-chüeh who had split off from the Western Turks were totally defeated by the Chinese and there followed a period of fifty years of slavery, which is referred to in pathetic terms in the Orkhon inscriptions. In 659 the Chinese subdued all the country of the Turks, but in 681 a new Khan arose named Kutlugh, who temporarily revived the prestige of his people by uniting them. He proclaimed himself Khan of all the Turks, and after defeating the Chinese, invaded the country of the Western Turks.

The Western Turks finally appealed to the Chinese to be allowed to occupy one of their provinces. On the death of Kutlugh, about 691, his younger brother Mé-chüeh became Khan of the Turks, who nevertheless still remained nominally vassals of the Chinese. Throughout his reign he continued to give trouble to the Chinese, but we are told that owing to the rapidity of the movements of the Turkish hordes, who would appear suddenly on marauding expeditions and disappear again before the Chinese troops could arrive on the scene, pitched battles were seldom fought.

On the death of Mé-chüeh in 716, Kultaghin, the son of Kutlugh, assumed command of the Turkish hordes and, having put to death the sons and brothers of Mé-chüeh, placed on the throne his eldest brother under the title of Bilgä Khan. In 731 Kultaghin died, and on his death the Chinese Emperor sent a mission under the Imperial seal to carry condolences to the great Khan and to make offerings on his tomb. The Emperor ordered an inscription to be engraved and a statue of the dead Khan to be erected, and a temple to be built, on the walls of which battle pictures were to be painted. Bilgä Khan in return asked for a Chinese princess in marriage. To this the Emperor agreed, but the Khan died by poisoning before the arrival of the princess. This was in 734. The Emperor again sent condolences and ritual offerings to the Turks and ordered a further inscription to be erected. Such is the origin of the two monoliths of the Orkhon.

Bilgä Khan was succeeded by his son, who died after a reign of eight years. His death was followed by great disturbances throughout the country of the Turks, and in 745 the chief of the Uighurs became possessed of all the country of the Turks and put to death their last Khan.

After this date the Turks are seldom mentioned in the history of China. The last mention occurs in connection with an embassy sent to the Emperor of China in 941. Without doubt, after their conquest by the Uighurs, these Western Turks began to lose their identity, and were gradually absorbed into other branches of the same race.

The Uighurs first appear in history in the sixth century, when they were known as the Kao-ch'e or "High Carts," being one of the two main divisions of the Turks in and around Northern Mongolia. They re-appear in the seventh century under a new name Hui-ho, which is probably the Chinese rendering of the Turkish Uighur. In 742 they conquered Mongolia from the Northern Turks. Their period of greatness was about 750-850, corresponding with the zenith of the famous T'ang dynasty. They had their capital at Kara Balgassun in the Orkhon country. Among their most important towns were Bishbalik, Kara-Khoja and Turfan. They were finally defeated by the Kirghiz. They attained a very high level of culture, and recent archaeological research has brought to light a vast amount of Uighur literature and art. From this we learn that Christianity, Buddhism and Manichaeism were all practised in their kingdom, the utmost tolerance being observed; but Manichaeism was the state religion. The Uighurs were certainly the most civilised of all the northern neighbours of China; and, though their kingdom was destroyed in 850 by a Northern Turkish Tribe, the Kirghiz, they by no means disappear from history. Down to the fifteenth century we constantly find small Uighur principalities and states springing up, while during the whole of this period the Uighurs were extensively employed in Muhammedan chancelleries, playing much the same rôle in the Government Offices of Turkestan as the Panjabi Hindus under the Delhi Moghuls and the Bengalis under the British in India.

The Uighur language bears the closest resemblance to the Turkish of the Orkhon inscriptions, and continued to be employed as a literary medium at any rate down to the twelfth century. Prior to the conversion of the Uighurs to Islam, their language had been widely used for the translation of Buddhist, Christian and Manichaean works, which have only been brought to light in recent years. The T'u-chüeh and the Uighurs are therefore the two great branches of the Turkish-speaking family with whom all the Turks of to-day may claim relationship if only on linguistic grounds.

If the Iranian civilisation had the upper hand in Turkestan it did not hinder the Turks from cultural development. Buddhism was studied by the Turks with all seriousness, and apart from translations from the Chinese into Uighur of the best-known canonical works, we have commentaries on the Abhidharma which have the appearance of notes taken by a Turk while studying the Chinese originals.

Finally Turkish got the upper hand in the whole region, so that by the end of the tenth century the Indo-Germanic languages, Soghdian, Oriental Iranian and Tokharian, had died out altogether.

Persian has, however, survived in old Soghdiana. For in Smarkand and Bokhara one still hears both Turki and Persian in the bazaar. This Persian, known as Tajiki, differs in many respects from the Persian of Iran proper, and in it we have words which are to be met with in the Shah Nama, but are no longer current in Persia. As you are all aware, the Soviet has created a separate Republic for these Persian-speaking Turkestanis called Tajikistan,

A few words may be said in conclusion on the names Turk, Tatar and Moghul, which have given rise to much confusion. With regard to the name Turk, there can be no doubt that it was the name by which the Turks were known to others and among themselves in Central Asia in the sixth, seventh and eighth centuries. In their inscriptions they speak of themselves by this name, while the Chinese T'u-Chüeh is obviously a corruption of the same word.

In these inscriptions they call their language Türkcha.

As for the word Tatar, it is probably derived from the Chinese word Ta-ta or Ta-tse, which first appears in the Christian Era and corresponds more or less to the Greek term "barbaros." It was applied by the Chinese to the peoples on their northern frontiers. The name Tatar is now only used by, and applied to, the Turks of the Volga and the Caucasus, the descendants of those Tatars who for several centuries ruled over part of Russia.

The names Mongol and Moghul have of course a common origin; and the Mongolians have survived as a race since the days of Chinghiz Khan. In the 15th century Russian Turkestan was known to Muslim writers as Moghulistan; and the famous Emperors of Delhi, the descendants of Tamerlane, were known as the Great Moghuls, though they were in reality not Moghuls but Turks. The Ghaznavid dynasty, which preceded them (c.900-1200 A.D.) in Northern India were, however, avowedly Turks, while the Slave dynasty which ruled over Northern India from 1206 to 1290 was founded by a Turkish slave named Kutbud-din. The reason why the Delhi Emperors called themselves Moghuls rather than Turks was probably not unconnected with their desire to claim descent from the great Chingiz Khan as well as from Tamerlane.

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

TUESDAY, OCTOBER 1. Automobile Engineers, Institution of, at the Royal Automobile Club, Pall Mall, S.W. 8 p.m. Prof. W. Morgan, Presidential Address, "The Member and the Institution."

WEDNESDAY, OCTOBER 2. Analysts, Society of Public, at Burlington House, Piccadilly, W. 8 p.m. (1) Dr. H. E. Cox, "Chemical Tests in Relation to Fur Dermatitis." (2) Mr. J. H. Coste, "Demonstration of a Nomogram for use in Gas Analysis." (3) Mr. P. S. Arup, "The Composition of Irish Winter Butter." (4) Messrs. W. R. Schoeller and H. W. Webb, "In-

vestigations into the Analytical Chemistry of Tantalum Niobium, and their Mineral Associates." XVI. Observations on Tartaric Hydrolysis. XVII. The Quantitative Precipitation of the Earth Acids and certain other Oxides from Tartrate Solution.

THURSDAY, OCTOBER 3. Arts, Royal Academy of, Burlington House, W. 4.30 p.m. Prof. Arthur Thomson, "Anatomy—The Erect Posture in Man and the Characteristic Features dependent thereon." Engineers, Society of, at Burlington House, Piccadilly, W. 6 p.m. Mr. W. J. Hadfield, "Some Road Questions."

FRIDAY, OCTOBER 4. Junior Institution of Engineers, 39, Victoria Street, S.W. 7.30 p.m. Mr. C. I. Hill, "Engineering Experiences on a Tea Estate in Assam."

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4011.

VOL. LXXVII.

FRIDAY, OCTOBER 4th, 1929.

*All communications for the Society should be addressed to the Secretary, John Street,
Adelphi, W.C.(2.)*

PROCEEDINGS OF THE SOCIETY.

ALDRED LECTURES.

NOMADIC MOVEMENTS IN ASIA

By SIR E. DENISON ROSS, C.I.E., PH.D.,

Director of the School of Oriental Studies,
and Professor of Persian, University of London.

LECTURE III—THE SELJUKS

(Delivered May 6th, 1929.)

In my previous lecture I attempted to describe the manner in which the Turks migrated or drifted westwards from their ancient habitats in Mongolia into the fertile basins of the Ili and Tarim rivers, and even into Soghdiana. I brought the story down to the beginning of the eighth century, when a final effort on the part of the Eastern Turks came near to bringing about the restoration of the United Turkish Empire, an effort which was frustrated by the diplomacy of the Chinese. Such was the position when the Arabs, after wasting upwards of fifty years in desultory raids into Transoxania, set about the serious invasion of that country under their famous general Kutayba.

Towards the end of the eighth century we find two Turkish kingdoms on the Jaxartes: on the upper reaches of this river were the Karluqs, and on the lower the Ghuzz or Oghuz, a section of the Western Turks. In and around Kashghar there was a third powerful Turkish kingdom belonging to the Kara-Khanids. [The main Uighur kingdom first established in the middle of this century was brought to an end, as we have seen, by the Kirghiz in the middle of the ninth century.]

As we are only concerned with the migrations of the Turks I must now pass at once to the last decade of the tenth century, which saw the first beginnings of that great infiltration of this race into the middle and near East.

In the interval the Abbasid Caliphs had become masters of all the country lying between Khorezmia on the North, Chinese Turkestan on the East and India on the South ; but already, at the beginning of the ninth century, the Caliph was losing his hold on the Eastern provinces of Islam ; and by the end of that century we find there the Samanids, a native Persian dynasty exercising independent rule, though outwardly acknowledging the authority of Baghdad, with their capital alternatively in Samarkand or in Bukhara. The Samanids at the height of their power ruled over Khurasan, which then extended to the Oxus, and included Herat and Merv, Transoxania, the province of Ghazna extending from Balkh to the Panjab, and Khorezmia. Their most troublesome neighbours were the Turks on their Eastern frontiers. During the whole of the tenth century there were frequent incursions or invasions made from either side. We also hear of hordes of Oghuz Turkomans being allowed by the Samanids to occupy land in Transoxania, land suited only to nomads, and engaging in return to protect the frontiers from all inroads, and it is in this connection that we first hear of Seljuk, the grandfather of the two brothers who founded the Seljuk Empire.

We read in Gibbon's Chapter 57 the following accurate description of the situation in Central Asia at this period. " In the decline of the Caliphs, and the weakness of their lieutenants, the barrier of the Jaxartes was often violated : in such invasion, after the retreat or victory of their countrymen, some wandering tribe, embracing the Mahometan faith, obtained a free encampment in the spacious plains and pleasant climate of Transoxania and Carizme. The Turkish slaves who aspired to the throne encouraged these emigrations, which recruited their armies, awed their subjects and rivals, and protected the frontier against the wilder natives of Turkestan."

In the year 985 a branch of Turkomans under the leadership of Seljuk, separated from their fellow-tribesmen in and around Jand, in the lower reaches of the Jaxartes, turned Muslim and were allowed by the Samanid ruler to settle in Nur, north-east of Bukhara.

The most redoubtable Turks on the Eastern frontier of Transoxania were at this time the Kara-Khanids, who are reported by legend to have embraced Islam in the middle of the tenth century. The Kara-Khanids, as near neighbours of the Uighurs, were probably more cultivated than the Turkoman Seljuks. In 992 Bukhara was entered by Bughra Khan, who shortly after withdrew, owing, it appears, to ill health. But a fresh invasion took place in 995, and the Samanid king (Nuh), whose forces had been considerably reduced by revolts within his kingdom, decided to appeal for assistance from Sebuktagin, a Turk who was governor of Ghazna, and had rendered great services to the Samanids. 'In 999 Sebuktagin died and was succeeded by his famous son

Mahmud of Ghazna, who in the course of his thirty years reign made himself master of all the territory possessed by the Samanids.

The Ghuzz Turks had by this time arrived in vast hordes in Transoxania, and already in the Samanid period many of them had settled round about Samarkand and Bukhara. The Ghuzz, like the Turkomans, belonged to the Western Turks, and on arrival in Muslim territory soon adopted the religion of the Arabian prophet and always became rigidly orthodox Sunnis, a circumstance which had a very far reaching influence on the history of Islam.

Later on bodies of these Turks began to penetrate into Khurasan from both sides of the Oxus, only to be driven out again by the Ghaznavids, and scattered westwards as far as Hamadan and Mosul, robbing and pillaging as they went and making good government impossible for the lesser princes of Persia and Mesopotamia. Thus gradually the whole of Northern Persia was overrun by Turks, who formed a valuable nucleus of partisans for the more or less organised hordes which were soon to arrive in Persia under the leadership of the indomitable Seljuks. One naturally asks what particular quality it was which differentiated the Seljuks from the numerous other hordes which were continually passing into Khurasan and beyond.

The sudden rise of the Seljuks may probably be due solely to the personal factor. Really capable men like Tughril and his brother Chaghri by sheer individual prestige attracted to their banners Turks of any horde that was in their neighbourhood – just as Chingiz Khan, though actually a Mongol, attracted to his side countless Turks.

That we know so little of the rest of the Ghuzz is no doubt due to the fact that if they found no great leader, the name of their tribe or tribes would be ignored by native historians; and having reached the end of their wanderings, they either became merged in the local population, or attached themselves to some new chieftain who might be moving further afield.

We next hear of the Seljuks under the two brothers Tughril Beg and Chaghri Beg, the grandsons of Seljuk, forming an alliance in 1034 with the Ghaznavid Governor of Khorezmia, who had revolted against his masters. In the following year, dissatisfied with the treatment they received from the "Khwarazm Shah," they decided to follow the example of the other Ghuzz and cross the Oxus into Khurasan, where they managed to make themselves masters of the important towns of Nasa, Merv and Nishapur. A battle at Dandanqan in 1040 finally put an end to Ghaznavid rule in Khurasan and in the words of Gibbon "founded in Persia the dynasty of the Shepherd Kings."

Mas'ud of Ghazna, who had been during this time mainly engaged with the affairs of India, now, too late, awoke to the gravity of the situation in the North, and made several attempts to drive the Seljuks out of Khurasan: as did also his son Maudud, who succeeded him in A.D. 1042. The actual possession of this great province continued a question of dispute down to A.D. 1059, when, by a treaty, it was definitely ceded to the Seljuks together with Balkh, Herat and Sistan.

While Chaghri Beg was left to consolidate the power of the Seljuks in Khurasan, Tughril Beg was pursuing a career of conquest in the West; and parcelling out his newly-acquired territories among his numerous brothers and nephews. These early conquests included Iraq, Kirman, Azarbaijan, Hamadan and Gurgan. He selected Rayy as his first capital.

Persia was at this time split up into a number of independent principalities, which had nothing in common but a nominal recognition of the Caliph and there could be no question of any combined effort on their part to show a united front to the advancing armies of Tughril. The once powerful Buwayhids who, since the middle of the tenth century had exercised complete control over the Caliphs of Baghdad, and had founded states in Southern Persia and Iraq, owing to family feuds had lost much of their former power and influence, and although they were able, by obstinate bravery, to delay Tughril's progress through Southern Persia—notably at Kirman in 1047 and at Ispahan in 1051, which only surrendered after being completely starved out—they were obliged in 1055 to recognise defeat.

In 1054 Tughril determined on a final coup, and after securing his flank by a successful raid into Azarbaijan, marched direct on Baghdad. Here the political situation was all in his favour. The Shi'a Buwayhids had placed the affairs of the orthodox Caliph under the control of a certain Basasiri, whose position had been much weakened by the hostility of the Beduin Chiefs of Iraq. Baghdad was moreover the scene of constant disputes between the Sunnis and Shi'as. The arrival of the orthodox Tughril in the neighbourhood of Baghdad must have inspired new hope in the heart of the Caliph Kāim, who was even suspected of having invited the redoubtable Turk to come and deliver him from his Shi'a guardians.

In December, 1055, Tughril entered Baghdad in state and was loaded with favours by the Caliph, who seated him on a throne and clothed him with a robe of honour. The conversation they now held was interpreted by Tughril's famous vezir Kunduri. Tughril probably only spoke Turkish, for none of the Seljuks were educated men, and we have it on good authority that even Sanjar, the last of the great Seljuks, was illiterate. They left learning and the encouragement of learning to their Persian ministers. We may recall that the great Emperor Akbar of Delhi is said to have been illiterate, but no one could accuse him of lack of culture.

Meanwhile, at the approach of Tughril, Basasiri had fled, and although no opposition was raised against the Seljuk's entry into Baghdad, the presence of his nomad hordes was by no means welcome to the inhabitants, and in order to avoid possible disturbances, and thus preserve the political advantages he had gained, Tughril shortly afterwards left Baghdad, but not before giving his niece, the daughter of Chaghri Beg, in marriage to the Caliph, and thus cementing the good understanding arrived at between the first Arab in the land and the self-made Turk. During the twelve months which followed Tughril and his generals succeeded in subduing Mosul and Diyar Bekr.

Meanwhile, Basasiri was planning revenge. He gathered round him many of the Beduin chiefs of Iraq, intrigued with the Fâtimids of Cairo and even stirred up dissension among the Seljuks themselves, by inducing Ibrahim ibn Inal, a cousin of Tughril's, who had been made governor of Hamadan, to revolt. It must here be noted that the Turks always retained the idea of the family, and though they recognised the head of the clan, they did not aim at sole and individual rule by one chief, but bestowed newly conquered territories on their immediate kinsmen, giving them almost independent powers. This same characteristic is equally notable in the case of the Mongols at a later period, when Chingiz divided his vast Empire among his sons. This was a very different policy to that pursued by other oriental dynasties, whose kings on accession to the throne were in the habit of putting to death, or at best blinding, all potential rivals, especially their brothers. The subsequent history of the great Seljuks goes to show how dangerous this policy might become when the Nomads began to settle in a strange land. The revolt of Ibrahim ibn Inal was a case in point, and the situation was only saved by the prompt action of Tughril, who sent three of his nephews to punish the rebel, and having captured him, caused him to be strangled with the string of his own bow.

Tughril next turned his attention to Basasiri and his Beduin chiefs who had, in the interval, re-occupied the Residency in Baghdad; and in a fierce engagement which ensued, Basasiri, deserted by his new allies, fell into Tughril's hands and was beheaded. This was in 1059, and after this success the founder of the Seljuk state refrained from all further aggression and set about the consolidation of his Empire.

Chaghri Beg had just died, and his son, Alp Arslam, was given the Governorship of the Eastern provinces. Chaghri's widow, who was his second wife and the mother of his son Sulayman, was now married to Tughril.

Although Tughril seems to have grown weary of campaigning, his ambitions were not altogether satisfied, and in spite of his old age he had made up his mind to ally himself yet more closely with the Caliph, and sent his vezir Kunduri to ask for the hand of the Caliph's daughter. But in spite of the deep obligations of the Caliph towards the man who had released him from the Shi'a tutelage, and in spite of the fact that Tughril could at any moment dethrone him, his aristocratic Arab blood revolted against such an alliance with this crude Turkish chieftain, who was devoid of all the elegancies and nearly seventy years of age, and he at first refused. Some writers have also suggested that the initial refusal was prompted by a determination to make the price as high as possible, and indeed one of the conditions proposed was the immediate restoration of the Caliph's sovereignty over Baghdad.

Not before the end of 1062 was Kunduri able to report a successful termination to these long drawn out negotiations, and at the beginning of the following year preparations were made for the marriage, which was to take place at Tughril's capital, Rayy. The princess on reaching Tabriz learnt, (we may

imagine to her great relief) that the bridegroom had died after a few days of illness. Thus was the great Tughril, on whom fortune had been so constant an attendant, cheated of his last great ambition.

In less than twenty-five years, from their first successes in Khurasan in 1037 down to the death of Tughril in 1063, these two brothers had conquered the whole of Persia proper, and what is perhaps equally remarkable, had introduced orderly government into a country which for nearly two hundred years had been the scene of discord and civil war. But it was not only Persia that was resuscitated by the conquering Seljuks; Islam itself seemed on the eve of disruption: neither the Sunni nor the Shi'a Caliphs were able to give it anything approaching its earlier homogeneity; there was no really paramount power in Asia. It was Tughril who revived the waning prestige of Islam; who postponed for nearly two hundred years the extermination of the Baghdad Caliphate, and it was his conquests which paved the way for the foundation of the last great Muslim Empire, that of the Ottomans of Turkey. The failure of the Crusaders to make a lasting impression on Asia may also be in a large measure accounted for by the existence of this strong Central Empire.

It is one thing to conquer, and another thing to hold, and we must not forget that the Turks, though great soldiers, were very seldom administrators; but, like the early Caliphs of Baghdad, they turned to the Persians; and if the Seljuks were fortunate in their leaders, they were equally fortunate in the great Persian ministers they attached to their service; without whom it is unlikely that they would have been so clearly distinguished from the many hordes of Turks who plundered their way across Asia.

It was, however, a great misfortune for the oriental world that the race which contributed most to the strength and continuance of Islam should have been illiterate and uncultured barbarians. This epithet does not, of course, apply to all the Turks; for long before the time of Mahmud of Ghazna—who at any rate attracted to his court the first men of letters of his day—there were branches of the Turks, notably the Uighurs, who had taken to a settled life and had developed a literature of their own. The nomad Turk, however, had no predilection for letters or art, and in spite of the generous patronage, which men like the vezir Nizam ul-Mulk gave to literature and science, the triumph of the Turk over the Arab gave a permanent set-back to that appreciation of Western thought and science which the Arabs had displayed immediately after their emergence from the desert. For the Arabs who brought nothing with them but their rich language and its fine poetry, at once showed an eagerness to benefit by their intercourse with both Byzantium and Persia, and from the treasure house of Greek Science laid the foundations of a vast literature comprising philosophy, mathematics and the natural sciences, which though it owed its origin to Greek or Syrian originals, soon took on a character of its own and gave rise to various native schools of thought.

The Turks, who brought nothing with them, cared for none of these things,

and it was only thanks to their cultured Persian advisors that Arabic learning and Persian literature survived. It is true the Seljuks did not, as did the Mongols two hundred years later, set out to destroy the monuments of Muslim literature, and this must be reckoned to their credit ; for the Mongols, like the Seljuks, had in their service men like Rashid ud Din and Juwaini the historians, who were the intellectual equals of Kunduri and Nizam ul-Mulk, but were powerless to stay the wholesale destruction of the libraries of Baghdad wrought by Hulagu.

It should also be borne in mind that although the mass of these hordes were quite rough, their leaders often showed themselves susceptible to refined influences. A famous Muslim Geographer of the middle ages, speaking of the Turks, observes : " Their princes are warlike, provident, firm and just ; they are distinguished by admirable qualities : the nation is cruel, wild, coarse and ignorant."

From the point of view of the peaceful merchant or cultivator it is difficult for us to judge whether they were able to notice any difference between the raids of the Ghuzz and the invasion of the Seljuks ; both were probably more alarming than the constant wars between the Ghaznavids and the local Persian princes. In these last it was mainly the regular soldiers which were engaged, under trained generals, whereas the Ghuzz, who were solely bent on loot and pillage, were allowed to practice without restraint every kind of depredation. The military adventures of the princes and their generals often make good reading, and their prowess fills us with admiration—but one is apt to feel the aimlessness of it all and to be disgusted by the wanton waste of human life, and to regret the absence of all cultural interest outside the field of religious fanaticism : a thick mist of battle, murder and rebellion seems to cast its shroud over every page of Islamic history and leaves one with the impression that the average inhabitant of Persia and Central Asia spent his days in either apprehension or terror. And yet we know that in spite of these constant wars and rebellions the system of administration under the Samanids and the Seljuks was elaborate and sound in theory, and that on the whole justice was well administered. Moreover, in the midst of all this rivalry of warring chiefs and the burnings and pillagings of towns, the student in his cell, the astronomer in his tower, the poet at the court and the preacher in the mosque, still existed ; but as they are for the most part ignored by the chronicler of the day we must discover their existence by piecing together the broken mosaics which may be found after careful search in the rare books of travel, and in those rare passages in Persian poetry which contain personal allusions or references to passing events.

Thanks to the preservation of Nizam ul-Mulk's " Book of Government," we have very precise information regarding his, Nazim ul-Mulk's, system of administration. As has already been mentioned, in the eyes of the Turkish nomads the Empire was the property of the whole family of the Khan ; and not only were entire provinces given over to uncles, brothers and sons, who

ruled them in their own name, but there was further introduced a system of territorial fiefs (*igtd's*) which were distributed to distinguished soldiers in lieu of payment of grants or in part payment. Nizam ul-Mulk himself tells us that this was an innovation and that in the Ghaznavid Empire troops were paid in money only. Fief holders were only entitled to demand a specific sum from the inhabitants and had no rights over the persons' property, wives or children of the population.

The great vezir also describes the difficulties that were encountered in training nomad chiefs to adopt a sedentary life and to submit to the same administration as the settled population. Under former Persian rulers there had been a strong force of "guards" composed of bought slaves and mercenaries, and some means had now to be found whereby the nomad invaders might be brought under the same system. In his "Book of Government" he gives a most interesting account of the measures he adopted for training large numbers of young Turkomans to become servants of the court, without interfering with the interests of the settled population. He was also strongly opposed to the holding of more than one post by any individual, as this tended to increase the number of unemployed in the official class, who were always an element of unrest.

Sanjar, having spent twenty years as virtual ruler of Khurasan, was destined to spend forty years as master of the whole Empire. His reign was distinguished by great successes and great reverses. Among the former were his conquests of Ghazna, Samarkand and Sistan. Among the latter was his defeat at the hands of the Kara-Khitaïs, which deserves special notice on account of its curious repercussion in Europe. Mahmud Khan, the Kara-Khanid King of Transoxania, had invoked Sanjar's help against the Karluk Turks who had invaded his country. The Karluks in their turn appealed for aid to the Gur-Khan (or Universal-Lord) of another group of Turks known as the Kara-Khitaïs. Negotiations for a peaceful settlement having broken down, mainly owing to the haughty attitude adopted by Sanjar, a sanguinary battle was fought in the Katwan steppe in September, 1141, in which the Seljuk army was totally defeated and fled, leaving half the army dead or wounded. The Kara-Khitaïs in the same year occupied Bukhara.

The reports of this defeat, which reached Europe shortly after, led to the belief that the Seljuks had been defeated by a Christian prince on their Eastern frontier; and hopes were cherished that a new Christian ally had suddenly appeared who would simplify the Crusaders' task of attacking the Seljuks in the rear. It was actually this rumour which led to the belief in the Christian kingdom of Prester John in Central Asia; and there was this much of justification for the report, in that among the Turkish tribes fighting for the Gur-Khan some professed the Christian faith.

The main cause of anxiety to Sultan Sanjar during most of his reign was Atsiz, the Khwarazm Shah who succeeded to the Governorship of Khorezmia

in A.D. 1128. Although when he died he was still the vassal of the Seljuk Sultan, he must be regarded as the real founder of the dynasty of independent Khwarazm Shahs, who in the thirteenth century were the last bulwark between Persia and the invading Mongols. The story of the constant revolts of Atsiz and the repeated expeditions into Khorezmia of Sanjar make wearisome reading, and need only be referred to because they certainly hastened the break-up of the Seljuk Empire.

It was however his near kinsmen the Ghuzz nomads in Khurasan who finally brought Sanjar's rule to an end. In A.D. 1153 the leaders of these Ghuzz, enraged at the Sultan's attempt to subdue them to the rule of Persian officials and tax-collectors, rose in revolt, and not only destroyed his army but took the Sultan himself prisoner. He remained in their hands until 1156, when some of his faithful retainers managed to obtain his release by bribing his custodians. He was brought safely to Merv and began to collect a new army, but grief at the ruin and desolation of his country, combined with old age—he was then seventy-two—caused his death a few months later. In these tragic circumstances did the Empire of the great Seljuks come to an end in A.D. 1157.

EXHIBITIONS OF APPLIED ART.

MODERN TENDENCIES IN DECORATION. Messrs. Heal's, Tottenham Court Road.
Exhibition open till Oct. 31st.

Mr. Ambrose Heal is a modern rather in the way that Mr. Bernard Shaw is a modern. He is direct and earnest, and never more conservative than when he is being emancipated. Much of Mr. Heal's work, so excellent of its kind, seems to say: It's all right, my dear man and woman in the street: you may come near me, you may even acquire me, and I shall do you no harm. I am really as innocent as aspidistras.

And so it is. Far, far better than aspidistras, too, and better than much that is truly antique or truly modern. Mr. Heal's work is not what we mean by modern. It insists on the intrinsic attractions of grain. But did not the eighteenth century do the same? The eighteenth century insisted on something else at the same time: the twentieth century tends to expect materials and techniques to shoulder responsibilities that are beyond them.

Now in order to bring out the character of a material, the artist or craftsman has got to do more than, so to speak, make smooth its path by choosing "artless" forms. Nothing is more "arty" than artlessness, unfortunately. When art is not primitive it must have urbanity; there is no possible compromise.

To come to the present show at the Mansard Gallery. The furniture is in three kinds of wood: macassar ebony, walnut and oak. The first named is luxurious. The clear cut design of the suite in which it has been applied brings out the rather unsympathetic hardness of the wood, which is here inlaid with ivory. Altogether pleasanter is the French walnut suite, though the straight grain attracts too much attention to itself. It is advisable *celare artem* more than this. Some of the designs in oak are still more agreeable. They are always educative: they state the problem well even when they do not solve it.

The general level of the textiles shown is a high one, and some of the patterns are very good. Artificial silk is here and there seen mixed with other materials, with a pleasant enough effect: less sheen is imparted than one might expect.

Some of the glass for table use is elegant. If one can be satisfied with something less than Corbusier and Lalique, a visit to the Mansard Gallery is worth making.

NOTES ON BOOKS

RECENT ENGLISH DOMESTIC ARCHITECTURE. 1929. Edited by H. de C. Hastings. London: the Architectural Press. 15s.

On the jacket of this book we see represented a sort of Mallet-Stevens or Corbusier house. At once our expectations are roused—or our fears confirmed. But in either case we shall experience a reaction when we open the book and turn over the leaves. For it is only at the very end that anything like the house on the jacket again makes an appearance. And then, on closer scrutiny, the similarity to Stevens-Corbusier work is found not to be very complete.

As the recent photographic exhibition at the R.I.B.A. gallery proved, English architects are not plunging enthusiastically into the ultra-modern movement where commercial buildings are concerned. The same restraint is shown in recent examples of English domestic architecture. Just as new plays woo London from an outer circle of theatres, so the new houses are making their shy *début* on the outskirts of the metropolis. Of the hundred plates in this book only about half a dozen represent anything like the twentieth-century manner.

The Silver End garden village houses are not in ferro-concrete, nor is their fenestration characteristic of the European tendency to make the windows run the whole length of the building. Brick is the material used; it is colour washed, so that one wonders whether the intention is to deceive the eye. There is absolutely nothing against deceiving the eye, but the deception, if such it is, fails here. The group of four cottages is most agreeable none the less, and also cheap, their cost working out at 11d. per foot cube. In general form they are to all intents and purposes a compromise between the modern geometric and the Queen Anne styles.

But this is beginning at the end. As Mr. Hastings says in his preface, "the houses have been arranged by the period in a rough chronological sequence, wherein the amateur of architecture may trace consecutively the effects of Tudor, Georgian, and modern Continental influences on contemporary thought." We start with a large and solid half-timber country house in irreproachable taste. Nor could erudition produce anything more satisfying than the house at Sandwich Bay by Mr. C. H. Biddulph-Pinchard. Those who disapprove of a great expenditure of money and ingenuity on recapturing effects of picturesque rusticity will not care for the thatched house on page 8. Its more modest tiled *vis-à-vis* perhaps just fails to charm by its very fidelity to a traditional method of panelling the walls. There results from this a stiffness which does not make for repose.

At Withington, Gloucestershire, as elsewhere, Mr. Leslie Mansfield's conservatism is shown to be justified. The vast Ayrshire mansion by Mr. James Miller is equally sober and reasonable. The design of Braydon Hall, which has affinities to the two foregoing, is more concentrated and—one would judge from the illustrations—more genial.

With two charming weather-tiled cottages, by Messrs. Imrie and Angell, and Baillie Scott and Beresford respectively, we leave the Gothic age behind and come to the stately, if somewhat complacent, renaissance house, Burdocks, by Mr. E. Guy

Dawber. The defects of 64 Park Street, page 35, are evident enough: unsatisfactory proportions and too many windows. No. 15 Church Row, Hampstead, on the other hand, is good: spontaneous without being particularly original, with excellent proportions and windows perfectly arranged.

The two examples given of Mr. Clough Williams-Ellis' work are puzzling. Caversham Place less so than the house at New Romney. Perhaps in a photograph the green-tiled mansard roof looks heavier than it does in reality. But that the house at New Romney has an air of whimsical accomplishment there can be no denying; it would be interesting to know how well it wore on increasing acquaintance. A certain apparent abruptness of colour contrasts is, perhaps unexpectedly, one of the most attractive points about Caversham Place. The proportions and spaces here are suavely elegant: not merely safe, but individual, *réussies*.

What one can see of the house, page 63, by Sir Edwin Lutyens, is of a fine four-square solidity. The same architect's house at Gullane, page 85, has a similar character, and is built on an interesting plan with a semicircular frontage.

It is a pity that no more complete view is given of the house at Sandgate by Mr. Basil Ionides than that offered by the two photographs on pp. 88, 89. There is no plan either, unfortunately.

Then with New Ways, Northampton, by Professor Behrens and W. J. Bassett-Lowke, we come to the frontiers of modernity. Mr. C. H. B. Quennell's house at Silver End, with slate roof and tall chimneys, is not going to make anyone write to the papers in alarm. But if anyone writes against Mr. T. S. Tait's Le Chateau, the defence will not be handicapped by any lack of ammunition for its artillery.

ARTIFICIAL SILK. By Ing. Dr. Franz Reinthaler, O.Ö. Professor für Technologie, Hochschule für Welthandel, Wien. Enlarged and Revised Edition, translated from the German by F. M. Rowe, D.Sc., F.I.C., Professor of Colour Chemistry and Dyeing, Leeds University. London: Chapman and Hall, Ltd. 21s. net.

Recent developments in the importance of the artificial silk industry have led to the appearance of a number of text-books, amongst which the present volume occupies a prominent position. It is not a mere translation of Dr. Reinthaler's original work, published in German in 1926, but has been revised and considerably enlarged by Professor Rowe. The general intention of the book can be gathered from the author's remark: "It is indeed particularly important that those engaged in merchanting textiles should obtain a deeper insight into the development and manufacture of artificial silks, in order that they may be in a better position to understand the manifold causes to which defective goods may be due"; to which Professor Rowe, in the Translator's Preface, adds: "At the present time no one concerned with textile materials, and particularly with the dyeing of them, can afford to neglect to become acquainted with such information on the manufacture, properties, uses, etc., of artificial silks as is available for publication."

The task which the authors have thus set themselves has been successfully performed. The main account of the four principal methods of artificial silk manufacture is preceded by a useful chapter on the chemical and physical properties of cellulose, and its behaviour under the influence of various conditions and reagents. The four methods themselves—viz., the nitrate, cuprammonium, viscose and acetate processes—are treated in considerable detail, and the recent modifications in the viscose process, introduced by Lilienfeld, receive due notice. A few subsidiary products, such as cellulose formates, Lilienfeld's ether silk, and thiourethane silk,

are also described; and a brief account is given of the so-called "staple fibre" industry, in which short lengths of fibre are worked up, sometimes in conjunction with wool. The latter process attained some importance during the war, but in view of altered conditions is no longer very widely used.

The properties of artificial silks next come under review, and in natural sequence an important chapter sets out the various methods of testing in vogue at the present time. In the latter connection it may be of interest to note that the fluorescence reaction under the influence of ultra-violet light, though important results were expected from it, seems to have been something of a disappointment, the effects being too much at the mercy of accidental factors.

As is well known, the dyeing of the product has been found in the past to give rise to problems of extreme difficulty, which at one time threatened to impose severe restrictions on the whole artificial silk industry; these, however, have now been for the most part overcome, and the successful methods in use, in so far as they have been divulged, are fully described. The manifold uses to which the final product can be put are next dealt with, though any description of the actual machines used in knitting and weaving has been judged to lie outside the scope of the book. In addition, some attention is paid to a group of other products which may be manufactured from spinning solutions; and there is also included a chapter, inevitably of a somewhat ephemeral nature, on the economic position of the industry.

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

MONDAY, OCTOBER 7. Automobile Engineers, Institution of, at the Merchant Venturers' Technical College, Bristol. 6.15 p.m. Prof. W. Morgan, Presidential Address, "The Member and the Institution."

Junior Institution of Engineers, at 16 St. Mary's Parsonage, Manchester. Annual General Meeting. Mr. H. Herring, Chairman's Address on "Machine Tools, Past and Present."

TUESDAY, OCTOBER 8. Arts, Royal Academy of, Burlington House, W. 4.30 p.m. Prof. Arthur Thomson, "Anatomy—The Trunk, its Bones and Muscles. The Surface Forms dependent thereon in Action and Repose." (Lecture I.)

Automobile Engineers, Institution of, at the King's Head Hotel, Coventry. 7.30 p.m. Prof. W. Morgan, "The Member and the Institution."

Illuminating Engineering Society, at 15 Savoy Street, Strand, W.C. 6.30 p.m. Opening Meeting. Report on Progress in Illuminating Engineering and Exhibition of Apparatus.

Marine Engineers, Institute of, 85/88 The Minories, E 6.30 p.m. Mr. Eskil Berg, "Electric Propulsion as applied to Passenger Liners."

Metals, Institute of, at Armstrong College, Newcastle-on-Tyne. 7.30 p.m. Mr. S. G. Holford, Chairman's Address.

Petroleum Technologists, Institution of, at the ROYAL SOCIETY OF ARTS, Adelphi, W.C. 5.30 p.m. A Symposium on the Estimation of Gum in Petrol. Speakers: Lt.-Col. F. J. N. Auld, Dr. E. W. J. Mardles, Dr. H. Moss, Mr. C. R. Wagner and Mr. Julius Hyman.

WEDNESDAY, OCTOBER 9. Metals, Institute of, at Thomas's Café, High Street, Swansea. 7 p.m. Mr. J. H. Grant, Chairman's Address.

Wireless Technology, Institute of, at the Engineers' Club, Coventry Street, W. 7 p.m. Annual General Meeting.

THURSDAY, OCTOBER 10. Aeronautical Society, at the ROYAL SOCIETY OF ARTS, Adelphi, W.C. 6.30 p.m. Mr. C. R. Fairley, "The Range of Aircraft."

Arts, Royal Academy of, Burlington House, W. 4.30 p.m. Prof. Arthur Thomson, "Anatomy—The Trunk, its Bones and Muscles. The Surface Forms dependent thereon in Action and Repose." (Lecture II.)

Electrical Association for Women, at Alexandra House, 20 Kinsway, W.C. 3 p.m. Mr. F. E. Kewley, "Electrical Cold that Keeps."

Metals, Institute of, at the Chamber of Commerce, Birmingham. 7 p.m. Mr. J. D. North, "Metals in Aircraft Structures."

At 83 Pall Mall, S.W. 7.30 p.m. Dr. S. W. Smith, Chairman's Address, "Some Factors in Solidification."

FRIDAY, OCTOBER 11. Chemical Industry, Society of (Chemical Engineering Group), at Burlington House, W. 8 p.m. Mr. J. Davidson Pratt, "Rationalisation—Its Meaning and Application."

Engineering Inspection, Institution of, at the ROYAL SOCIETY OF ARTS, Adelphi, W.C. 5.30 p.m. Mr. E. F. Law, "The Chemical Laboratory in Inspection."

Eugenics Society, at Burlington House, W. 8 p.m. Dr. E. O. Lewis, "Mental Deficiency—Present Policy and Eugenic Ideals."

Metals, Institute of, at University (Applied Science Department), Sheffield. 7.30 p.m. Mr. F. C. Robinson, Chairman's Address, "Some Notes on the Selection of Suitable Metals to Resist Corrosion."

SATURDAY, OCTOBER 12. Countryside, National Conference for the Preservation of the, at the Queen's Hotel Pavilion, Ambleside. 10 a.m. "A Policy for the Preservation of Lakeland." Speakers: Mr. G. L. Pepler, Prof. P. Abercrombie, and Mr. Ewart James. 8 p.m. "Safeguarding the Beauty of the Lake District as a National Heritage." Speakers: Sir Charles Trevelyan, Prof. P. Abercrombie, Mr. C. Williams-Ellis, and Sir Fabian Ware.

I.C.C. Horniman Museum, Forest Hill, S.E. 3.30 p.m. Prof. J. R. Ainsworth Davis, "Man and the Man."

SUNDAY, OCTOBER 13. Countryside, National Conference for the Preservation of the, at the Queen's Hotel Pavilion, Ambleside. 2 p.m. "Special Aspects of Local Preservation." Speakers: Mr. Hugh Walpole, Mr. H. J. Massingham, and Mr. H. H. Peach. 8.30 p.m. (1) Dr. H. J. Moon, "Bird Life of the District." (2) Dr. Vaughan Cornish, "English Scenery."

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4012.

VOL. LXXVII.

FRIDAY, OCTOBER 11th, 1929.

*All communications for the Society should be addressed to the Secretary, John Street,
Adelphi, W.C. (2)*

PROCEEDINGS OF THE SOCIETY.

ALDRED LECTURES.

NOMADIC MOVEMENTS IN ASIA.

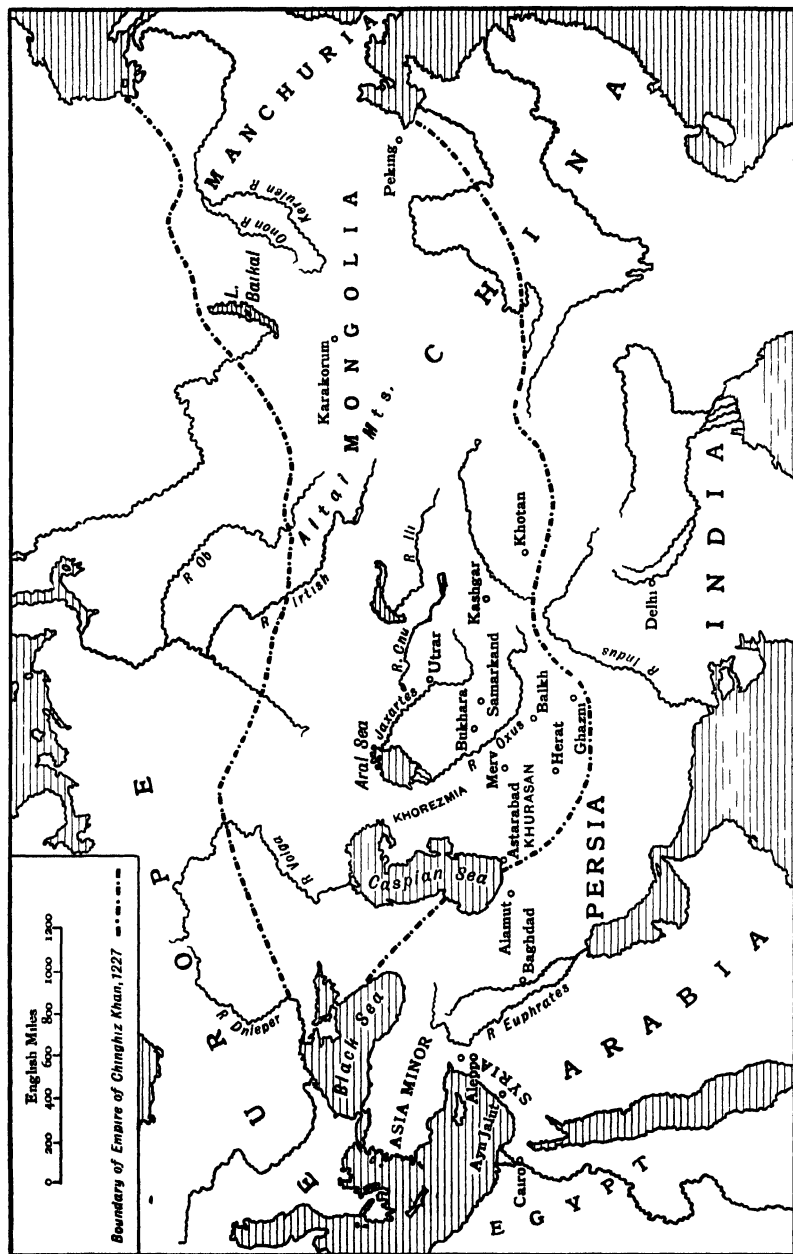
By SIR E. DENISON ROSS, C.I.E., PH.D.,

Director of the School of Oriental Studies,
and Professor of Persian, University of London.

LECTURE IV.—CHINGHIZ KHAN AND THE MONGOLS.

(Delivered May 13th, 1929).

In this, the final lecture of my course, I shall deal with the invasion of China and Middle Asia by the Mongols during the 13th century. It would take me outside the limits of this lecture if I were to dwell on the Mongol invasion of Europe. Although the migration of the Mongols was on an infinitely larger scale than the three movements of which I have already spoken, its influence on Asia has been less lasting than that of the others. The influence of the Arabs, for example, is ever before us in the wide-spread profession of Islam; the westward movements of the early Turks paved the way for the later supremacy of the Seljuks, which, in its turn, led to the subsequent domination of the Middle and Near East by the Ottomans. Mongol rule in Persia lasted barely 80 years and the Yüan dynasty in China rather less: and it is only in Southern Russia that we can readily detect to-day the ethnic results of the Mongol invasions, for it was in Russia and not in Asia that the descendants of Chinghiz Khan ruled for the longest period.



Map of Central Asia shewing the boundaries of the Empire of Chinghiz Khan

The name of Chinghiz Khan is commonly associated with the terrible invasions of Persia and Eastern Europe which were carried out by the forces which he had set in motion in the 13th century. It was in reality his grandson Hulagu who turned Baghdad into a smouldering charnel house, and it was another grandson, Batu, who invaded Europe. Chinghiz Khan himself never journeyed further west than the Oxus or further South than the Indus. During his active career, extending over fifty years, he was fully occupied with the unification of the Tatar tribes, the conquest of Northern China and the overthrow of the powerful king of the Eastern Provinces of the Islamic world. It was another grandson, the famous Kubilai Khan, who completed the conquest of China, and founded the dynasty of the Yüan, which endured for seventy-five years (1257-1332).

Harold Lamb, in his popular account of Chinghiz Khan, thus summarizes in a few words the career of his hero: "A Mongol nomad who had never seen a city, founded an empire that ruled half the world; a hunter and herder of beasts outmanœuvred and crushed the armies of three civilizations; a barbarian who did not know the use of writing made a code of laws for fifty peoples."

Chinghiz was something more than a ruthless barbarian at the head of countless savage horsemen, and though he and his successors carried destruction and desolation into the fairest lands of Asia on an unprecedented scale, what he achieved in unifying his empire, in organising his administration, and in codifying his laws, entitle him to unstinted admiration. As a world conqueror he does not yield in eminence even to Alexander the Great; as a legislator he may fitly be compared to Napoleon; as an administrator he showed a wonderful broad-mindedness in choosing the right men to serve him no matter what their nationality; as a general he was never out-manœuvred and as a soldier he was the bravest of the brave. It is none the less astonishing that a man who displayed such gifts of statesmanship, foresight, love of justice and real tolerance should have spread over half Asia the stillness of a churchyard. How can we account for his inhuman savagery? and whence did he derive the ambition to conquer all the world? He had nothing to preach, for the Mongols, unlike the Arabs, had no slogan, no new culture to offer the conquered peoples, nor did he care for the things those conquered peoples possessed.

If we consider for how many centuries the various hordes of nomads had hovered on the Northern frontiers of China, without ever making any movement on a really large scale, we shall better realize the outstanding importance of the part played by this extraordinary man. All previous movements, whether towards China or towards the Middle East, seem like so many aimless wanderings or haphazard raids which only took definite shape with the chance appearance of a great leader. With Chinghiz the case is different; for he seems from the first to have been inspired by a definite desire to conquer the whole world; with the sole object of getting other nations to provide for himself and his

family. But how, one asks, did a man, brought up in the simple environment of a nomad camp suspect the wide extent of Asia ?

He, of course, considered the organisation of his empire only from the point of view of nomad conquerors dominating civilized peoples. And what can have given birth to this spirit of World-conquest in this nomad chieftain ? His whole life was devoted to this one aim, and so powerful was this spirit in him that it seemed to survive his death and to pass as a natural heritage to his very numerous sons and their descendants. Though he cared nothing for human life, he cared a great deal about law and order.

I fear I cannot, in this lecture, indulge in the anecdotal side of the career of Chinghiz Khan, for I am only concerned with him as the leader of his people and not as a hero of romance. It is interesting to consider how Chinghiz Khan came to enjoy such popularity in the West. How so much romance attaches to his name that any popular work written round it is at once assured of a market. When did this taste for Mongolia in the Middle Ages first manifest itself ? Marco Polo, who also makes a best seller, belongs to the same land and age. The only pity is that scholars have not the time for writing popular books, and that consequently the writers of them know nothing of the sources and never seem to know where to find the best information, thus leading the public astray. Now the sources are exceptionally plentiful. First of all there are the Chinese histories of the Yüan dynasty, which tell us about his early career and his conquest of Northern China, but very little of his achievements in the West ; and secondly the Persian histories ; and thirdly the Mongolian histories, which are mostly legendary. The monumental *History of the Mongols* by Sir Henry Howarth, though a mine of information, is actually only a compilation of second-hand sources, mainly French and Russian. By far the most important account of Chinghiz Khan in English is to be found in Professor Barthold's *Turkestan down to the Mongol Invasion* (Publications of the Gibb Trustees, New Series, Vol. V, 1928).

Certain writers on Mongolian history have held that if Chinghiz had not achieved the confederacy and overlordship of the Mongolo-Turks, circumstances were such that one of his rivals would probably have done so ; for times were obviously ripe for the unification of these peoples.

In order to understand the career of Chinghiz Khan we must know something of the state of affairs in China at the beginning of the twelfth century. The anarchy which followed the fall of the T'ang dynasty in 906 gave the opportunity for a Mongolian tribe known as the Ch'i-tans or Khitais (whence our word Cathay) who had recently conquered Manchuria to invade Northern China. In 963 Southern China was brought under the rule of the Sung dynasty, who had to protect their frontiers, not only against the Khitais in the North, but against the Tunguts in Kan-Su. During the greater part of the eleventh century the Khitais and Sung rulers lived in peace. In 1114, however, a Manchu people called the Jurchen, who were vassals of the Khitais, revolted, and having driven

their former masters out of Northern China, founded a dynasty known as the Chin or Golden, with their capital at Peking. The chief of the Khitaïs, Ye-liu-ta-shih, fled with his people from China and, after years of wandering, arrived in the country of the Uighurs, in the Ili basin, who had been his vassals, and now received him as their over-lord. In the course of the next few years he conquered Kashghar and Khotan, destroying the power of the local dynasty of Kara-Khanids. He also made the Khwarazm Shah, Atsiz, his tributary, and captured Transoxania; finally, in 1141, he defeated the Seljuk Sultan, Sanjar, at Katwan, in the famous battle to which I referred in my previous lecture. He was now proclaimed Gur-Khan, or universal lord of the Turks, and his newly-founded dynasty is known as the Kara-Khitaïs. His kingdom now comprised all the lands of the Turks, from the country of the Uighurs to the Sea of Aral. He made Bala Saghun on the Chu river his capital. This empire lasted down to 1211, when their power was destroyed by the Khwarazm Shah.

At the time when Ye-lui ta-shih was forming his new Turkish empire in the West, the Tatars of Mongolia were rapidly growing in strength and were causing much anxiety to the Chin Emperor. One of the most formidable of these peoples were the Keraïts, a Turkish tribe who had been converted to Christianity by the Nestorian bishop of Merv in the eleventh century. Among the vassals of the Keraïts who aided them in their wars against the Chin was a confederacy numbering upwards of 30,000 families inhabiting the prairies round about the Onon and Kerulen rivers. The head of this confederacy was a certain Yisugai who married the daughter of the Keraït prince, by whom was born to him a son named Temujin, afterwards known as Chinghiz Khan.

On the death of Yisugai in 1167, Temujin, who was twelve years of age, was considered too young to succeed his father, and the King of the Taijiut was elected as chief of the confederacy. The active career of Temujin did not begin until twenty-one years after his father's death; not that the young man was idle during these years; on the contrary he was, with the wise counsel of his mother, steadily paving the way for his future career; and always watchful for the moment when he should be strong enough to seize the leadership of the confederacy, from which he had been excluded by reason of his tender age. Temujin, during these years managed to retain personal independence with only a very small following, but in 1188 this following had attained such large numbers that he felt strong enough to give battle to his rivals the Taijiuts. In the fierce contest which ensued, Temujin owed his victory of 13,000 over 30,000 men to his tactical skill, and with it began his triumphant career as a conqueror. His next task was to subdue the Merkits who lived round the lower shores of lake Baikal, and during the next four years he was engaged in constant warfare with them without any conclusion being reached.

Temujin was a vassal of the Keraït Khan. In 1203 a Mongol named Jamuka, who had been blood-brother (*Anda*) to Chinghiz and had subsequently turned

against him, took refuge with the Keraïts and managed by intrigue to turn the Keraïts against Temujin, and open war was declared. This put Temujin for the first time in a position of real independence ; and in a fierce battle which ensued, the Keraïts were utterly defeated, and their king fled to the king of the Christian Naimans, while the Keraïts themselves surrendered body and soul to Temujin.

In the following year Temujin attacked the Naimans who occupied the Southern plains of the Altai range, and were vassals of the great Kara-Khitai Emperor. With the defeat of the Naimans (1206), Temujin had made himself real lord of Mongolia. The Khan of the Naimans was killed, but his son, Kuchluk, escaped and fled to the Gur-Khan of the Kara-Khitais, whom he succeeded in 1212. It was only after the subjugation of the Naimans that the transaction of business in writing was instituted by the Mongols. A Uighur who had been the keeper of the seal to the Naiman Khan, was appointed to the same office by Chingiz, and was commissioned to teach reading and writing to his sons. The Uighurs thus became the first counsellors of the Mongols in their new capacity of a world state, and it is impossible to overestimate the important role they played in consolidating the Mongol Empire.

In 1206 Temujin held a grand *Kuriltai* of all the chiefs, at which he received the titles of *Sulu Bogdo* " Son of Heaven," and of Chinghiz, whence the name of Chinghiz Khan by which he has ever since been best known. (The real meaning of this title has not yet been discovered). Some further trouble from the Naimans and Merkits was disposed of without much difficulty. In the South West, Chinghiz was recognised by the *iduqut* of the Uighurs, who had been vassals to the Kara-Khitais (1209). Finally the Karluks and the Kirghiz submitted (1218).

Having thus effected the unification of the Tartars, Chinghiz turned his attention to the Tanguts of Kansu (1205-09). He aided the Öngüts and the Ch'i-Tans in their revolt against the Kin—and by 1215 the Mongols had possessed themselves of the Kara-Khitai Empire, and had revived the old Turkish State.

According to the *Chin Shih*, Chinghiz was tributary to the Chins down to 1211, when he withdrew his allegiance and made his first eruption into Northern China.

The conquest of Northern China was a very long and difficult task, for the Chin Manchus were a loyal and devoted people and offered the most stubborn resistance. It required 4 years for Chinghiz to capture Peking, which finally fell in 1215, and another three to subdue the rest of Northern China.

Seeing that my subject is the westward migration of the Mongols, I cannot dwell on the campaign in China.

After the fall of Peking, Chingiz again turned his attention to the Turkish tribes bordering on the Islamic provinces of Khorezmia and Transoxania, the Uighurs, the Karluks and the Kirghiz. Presumably for strategic reasons

he now transferred his capital from Karakorum to Bala Saghun on the river Chu, the former capital of the Gur-Khan of the Kara-Khitaïs.

It is at this point necessary to introduce the Khwarazm-Shahs, who by the end of the twelfth century had become masters of nearly the whole of the Empire of the Great Seljuks.

The famous battle of Katwan in 1141, was the result of an appeal made by Mahmud Khan, the Kara-Khanid king of Transoxania, to Sanjar for help against the encroaching Karluks, who in turn had invited the aid of the Kara-Khitaïs. The Khwarazm Shah at this time was, as we have seen, a vassal of the Kara-Khitaïs; this fact did not hinder him from carrying his armies into the West and the East, and 'Ala ud-Din Muhammad, who reigned from 1200 to 1220, by the year 1214 had made himself master of Khurasan in the west, had driven the Kara-Khitaïs out of Transoxania and had captured Balkh, Herat and Ghazna in the South. Sultan Muhammad in 1215 turned northwards to attack the Kipchaks, and it was in this campaign that he first came in contact with the Mongols, then pursuing the Merkits who had fled westwards. It is important to realise that this encounter did not in any way affect the relations of the Khwarazm-Shah with the Mongols, as will be seen from the exchange of friendly embassies which now followed.

In 1216 the Sultan, having learnt the news of the fall of Peking, sent an embassy to Chinghiz Khan, probably with the object of finding out more about this great conqueror. Chinghiz received the envoys well, and told them to inform their master that he regarded the Khwarazm-Shah as the ruler of the West, and himself as the ruler of the East; that he wished to remain on peaceful terms with him and to encourage free intercourse of merchants between their two countries. This would go to show that at this time Chinghiz was not dreaming of world-wide dominion; and certainly did not contemplate invading the Sultan's territories.

In 1218 Chinghiz sent a return embassy which was received none too graciously by the Sultan (probably in Bukhara); with a proposal for an alliance, or at least a regular commercial treaty. To this the Sultan, after some hesitation, agreed, though he was unwilling to recognise the supremacy of the Mongol Khan. Either simultaneously, or very shortly after the embassy, Chinghiz had sent a caravan of four hundred merchants to Khorezmia. On reaching the frontier port of Otrar, near the Jaxartes, these merchants were plundered and put to death by the local governor, and although it appears that the Sultan was in no way responsible for this wanton and cruel act, war between the two rulers was now inevitable. Before opening hostilities, however, Chinghiz sent three envoys to ask satisfaction for this outrage; one of these envoys was put to death by the Sultan's orders and the other two were sent back after having their heads and beards shaved.

War was now inevitable: but had not such a good excuse been offered to Chinghiz it was obviously only a matter of time for him to turn his attention

to these rich neighbouring lands, and the weakness of Sultan Muhammad's kingdom must sooner or later have proved an irresistible temptation to the mighty conqueror. We cannot therefore put the blame entirely on the Khwarazm Shah for the westward march of the Mongols, still less can we accept the suggestion made by a Muslim historian that the Caliph of Baghdad had invited Chinghiz to attack the Sultan, of whose power he was jealous.

In 1219 Chinghiz set out from his headquarters at the head of the largest force he had yet employed in one campaign, accompanied by his four sons. Seeing that a large force had to be left to continue the war in China, which had by no means ended with the fall of Peking, the actual Mongolian troops with Chinghiz have been estimated by Prof. Barthold at 70,000. To this number must be added the subjected peoples, including many Muslims, bringing up the total to about 200,000 men. The forces at the disposal of the Sultan were probably twice that number, mostly mercenaries. Professor Barthold thus describes the method of warfare always adopted by the Mongols in settled lands: "Everywhere the defenceless inhabitants of the villages were driven in large numbers to assist the Mongols in besieging the fortified towns; in storming fortifications the Mongols used to drive these unfortunate wretches in front of them so that they received the brunt of the hail of arrows and prepared the way for the army following them."

By the end of 1219 Chinghiz had established himself firmly in Transoxania, having captured both Bukhara and Samarkand. Chinghiz himself did not travel further west than Bukhara. The Sultan fled ignominiously into Northern Persia and managed to elude the pursuing Mongols. Finally he took refuge in an island of the Caspian, not far from the modern Astarabad, where in the following year he died in utter destitution. His valiant son Jalal ud-Din continued the unequal struggle, which ended with his defeat by Chinghiz on the banks of the Indus in 1221. For the Mongols had turned southwards and had captured and reduced to ruins Herat and Ghazna. It was while Chinghiz was resting on the banks of the Indus that he received news of a revolt in the north of his dominions which caused him to retrace his steps.

After spending a few months on the Indus, he returned by the way he had come and wintered in Samarkand. It was on this return journey that he was met by the Taoist priest, Ch'ang Ch'ung, whom he had invited to come and discuss with him religious matters. Ch'ang Ch'ung, accompanied by a Kerait Christian Chingay, set out to find the conqueror at the beginning of 1219, when Chinghiz was still on the Irtish, and only overtook him nearly three years later in the neighbourhood of Samarkand. The narrative of this holy man's journey, told by one of his disciples, is a document of the greatest interest and gives us a wonderful picture of China and Turkestan in the thirteenth century. The account of Ch'ang Ch'ung's first interview, through an interpreter, with the Emperor is worth quoting. The Emperor said: "You have come to see me, having travelled 10,000 li. I am much gratified." The Master

answered: "The wild man of the mountains came to see the Emperor by order of his Majesty. It was the will of heaven." Chinghiz invited him to sit down and ordered a meal to be set before him. After this he asked: "Sainted man, you have come from a great distance. Have you a medicine for immortality?" The Master replied: "There are means for preserving life, but no medicines for immortality." Chinghiz lauded him for his sincerity and candour, and, by imperial order, two tents were pitched for the Master east of the Emperor's tents.

The next three and a half years he spent in and around Transoxania. News of a revolt of the Tunguts made Chinghiz, in 1225, withdraw to the East, never again to turn his face Westward. It was while setting out on a fresh expedition into China, at the end of 1227, that he died at the age of seventy-two, an old and tired man. The funeral escort that bore his body to its final resting place put to death every person that they met—as was the Tartar practice—possibly so that the great Khan's burial place might not be divulged.

The history of the dynasty reports that when he felt death was approaching he thus addressed those gathered round him: "The best troops in China are those of T'ung Khan, but owing to their geographical position it is hard to surprise them," and proceeded to describe a stratagem whereby these people might be drawn out, and, being fatigued by a long journey, be open to attack, "*Then we can certainly destroy them.*"

In these dying words we see the undying love of conquest and destruction which possessed this most gifted and most brutal of conquerors even at the moment of death.

And now for a period of thirty years Central Asia was spared further horrors. It was during the reign of Chinghiz Khan's son, Ugedai that the invasion of Central Europe took place, and it was only the death of this prince in 1241 that saved Europe from being entirely overrun by the Mongol hordes. In 1248 another grandson of Chinghiz Khan, named Mönggü Khan, succeeded to the overlordship of the Mongols, and it was he who again set in motion fresh western campaigns, and for the special subjection of the western lands of Islam he appointed his brother Hulagu, who crossed the Oxus in 1253 at the head of some fifty or sixty thousand men. Such had been and still was the state of disorder and anarchy in Persia since the last Mongol invasion that Hulagu was actually met and welcomed on Persian soil by a number of local princes and governors, and his response to this invitation offers another example of that extraordinary mixture of destruction and good government which characterised Mongol rule.

One of Hulagu's first acts was the destruction of the great stronghold of the Assassins, Alamut. Marching through Persia by slow but sure degrees, he finally reached Baghdad on January 18, 1258. Many descriptions have come down to us of the terrors of the sack of Baghdad and the destruction of her buildings, the slaughter of her inhabitants, and the murder of the Caliph.

Without quoting any of these I would like to mention two anecdotes which illustrate the terror which the Mongols inspired. These men rode about on little ponies, their toes almost dragging on the ground, armed only with bows and arrows. It was said that a single Mongol would enter a village, wherein were many people, and would continue to slay them one after another, none of them daring to raise a hand against this horseman. Another Mongol, having taken a man captive, but having no weapon wherewith to kill him, said : " Lay your head upon the ground and do not dare to move," and he did so, and the Tatar went and fetched a sword and returned and killed him.

A Persian related the following : " I was going with seventeen others along a road and there met us a Tatar horseman, who bade us bind one another's arms. My companions began to do as he bade them, but I said : ' He is but one man, why should we not kill him and flee ? ' They replied : ' We are afraid,' and not one of them dared to move, so I took a knife and killed him."

There still stands in Baghdad to-day a beautiful minaret-shaped tower, which, the latest researches seem to prove, was built by Hulagu himself ! It is interesting to note that the chief commander of Hulagu's forces at this time was a Christian Nestorian named Kit Buka ; moreover, Hulagu had himself married a Nestorian lady named Dokuz Khatun, who was the grand-daughter of the last King of the Keraites, Wang-Khan Tughril.

Having thus completed one of the most terrible deeds recorded in the history of the world, Hulagu continued his western march in the hope of subduing the remaining Muhammadan states. Crossing the Euphrates he carried havoc and slaughter into Mesopotamia and Syria. In Aleppo alone he put 50,000 people to the sword. But even the Mongol resources in men were nearing an end ; for at the same time they were fighting in China and Southern Europe ; and Hulagu now at last met an enemy who was prepared to stand up against him in the person of the Mamluk Sultan Baybars. In 1260 on the field of Ayn Jalut near Nazareth, the Mongols met with their first defeat, and Egypt, Syria, Arabia and Asia Minor were saved from sharing the fate of Baghdad.

In 1259 Mangu Khan was succeeded by his brother, the famous Kubilai Khan (of Xanadu fame) who shortly after conferred on Hulagu the title of Il-Khan, or Provincial Khan, of Persia, a name by which the dynasty of Hulagu and his successors is known.

Hulagu dying in 1265 was succeeded by his son Abaqa, who also suffered a defeat at the hands of Sultan Baybars in 1277.

The Mongols had hitherto shown themselves tolerant towards all religions, except Islam. Chinghiz Khan professed Shamanism, and his wife was Christian. They had, however, like the Seljuks, been quick to appreciate the administrative genius of the Muslim Persians, and gathered round them men of science, poets and historians, and the 60 years of Il-Khanid rule in Persia was rich in literary achievement. The wonder is that those cultivated Persians like Juwayni and Rashid ud-Din, the administrators and historians, could bring themselves

to serve the men who had laid waste their country and destroyed so many libraries.

A similar case is offered by the willing service rendered to the unlettered Seljuks by men like the Vezirs al-Kunduri and Nizam ud-Mulk who were also both historians.

During the rule of the Il-Khanids (1295-1304) Persia enjoyed something more nearly approaching peace and quiet than she had known for centuries. The accession of Ghazan the Seventh Il-Khanid, who adopted Muhammadanism with strong Shi'ite proclivities, marks the definite triumph of Islam over Mongol heathenism and the beginning of the reconstruction of Persian independence. His conversion was regarded with disfavour by many of the Mongols, and led to rebellions which Ghazan suppressed with a ruthless hand.

He was constantly engaged in war with the Mamluks of Egypt with varying success, but finally in 1303 his forces were utterly defeated by the Egyptians, and one can picture the exultation of the inhabitants of Cairo when they beheld, being led through the city as prisoners, 1600 of these terrible Mongols, each bearing slung round his neck the head of one of his dead comrades. Ghazan never recovered from the vexation and shame of this defeat, and died in the following year. E. G. Browne thus writes of him in his *Persian Literature under Tartar Domination*: "The mourning for his death throughout Persia was universal, and appears to have been sincere, for he had restored Islam to the position it occupied before the invasion of Chingiz Khan, repressed paganism and reduced chaos to order He was devoted alike to arts and crafts and to the natural sciences, especially to architecture on the one hand and to astronomy, chemistry, mineralogy and botany on the other. He was extraordinarily well versed in the history and genealogy of the Mongols, and besides Mongolian his native tongue, was more or less conversant with Persian, Arabic, Chinese, Tibetan, Kashmiri and, it is said Latin. . . . Previous Mongol sovereigns had, in accordance with the custom of their nation, always taken measures to have the place of their burial concealed. Ghazan, on the other hand, specified the place where he should be buried, and spent large sums in erecting and endowing round about his mausoleum a monastery for dervishes' colleges, a hospital, a library, an observatory, a philosophical academy, etc. etc."

It is indeed curious to contrast this passage with those relating to the sack of Baghdad, and to realise that less than fifty years after the merciless destruction of all that Islamic culture stood for by Hulagu, his great grandson should as a devout Muslim devote so much time and money to precisely the contrary object, though Ghazan could not of course bring back the dead to life!

Ghāzān was succeeded in 1305 by his brother Uljaitu, who had been baptised into the Christian Church as a child, but was afterwards converted to Islam by his wife. He corresponded with various European courts, and some of the letters on both sides are extant, but he seems to have hidden from Pope Clement

V, Philip le Bel and Edward II the fact that he had renounced Christianity.

I have now reached the end of my lectures, but I fear that the ground which I had hoped to cover could not fittingly be compressed into the allotted space. I shall, however, be satisfied if I have succeeded in giving you some idea of these great semi-military migrations which form the outstanding landmarks in the history of Central and Middle Asia between the rise of Islam in the VII century and the fall of the Baghdad Caliphate in the XIII. Although I have avoided as far as was possible the introduction of unfamiliar names, I fear their number is great. There is, however, no reason why such names should remain unfamiliar to us, for our knowledge of history should certainly include that of Asia, and there is no reason why Oriental heroes and the geography of Asia should not become part of our general knowledge.

NOTES ON BOOKS.

UNEMPLOYMENT: ITS CAUSE AND CURE; AN ENQUIRY AUTHORISED BY THE GENERAL FEDERATION OF TRADE UNIONS. Summarised by W. A. Appleton, General Secretary. London: Philip Allan & Co., Ltd. 5s. net.

The summarist, Mr. Appleton, in a formal presentation to his Federation (pp. V-VII), mentions nineteen persons who have helped by taking direct or indirect part in the production of this book; and expectancy may be stimulated by the hope of something exceptionally exact, pertinent and profound, as being the joint effort of twenty select individuals.

The text commences on p. 1 with a somewhat impertinent truism:—"The fact of unemployment needs no demonstration." We have discursive items till we reach the middle of p. 3, where we read of the prominent place now given to "repeated assertion." After this the actual subject matter of the book comes well to the front in an effort to instruct the reader as to "what is meant by causes." We are told that some of the helpers did not "clearly understand that causes are antecedents invariably and unconditionally followed by certain effects."

Mr. Appleton appears here to be solving lightly and assertively a problem which has baffled thinkers through the ages. Let us make an application of his doctrine. One may say that for us non-polarites night invariably and unconditionally follows each day; therefore night is the cause of day. Another may similarly argue that day is the cause of night. Thus we arrive at a contradiction or an absurdity, and the doctrine of sufficient reason, as used by Leibnitz, gives us no help in making a choice. In addition, Mr. Appleton, who seems to think that he holds the key to the problem of the ages as regards causation, refers vaguely on p. 3 to "—the modern conception of various causes combining—"; but he does not seem to accept that doctrine which comes first from a thoughtful study of the calculus. This doctrine is that summation can only be exactly or usefully applied to such factors, data, features, elements or subjects as possess some inherent and definitely measurable aspect of quantity common to all of them; a doctrine often lost sight of in our day.

The concluding chapter, pp. 162-182, is termed an appendix, and it treats of "Foreign Exchanges in relation to Unemployment." The author, Mr. R. F. Harrod, is introduced to us on p. vi as one who attended early discussions, but

whose University work at Oxford prevented further attendance. Mr. Harrod lucidly, pertinently and concisely discusses the factors which make sudden and considerable variations in foreign exchange so embarrassing in relation to contracts and manufactures, pp. 163-164. Further, on page 164, he commences a useful study of depreciation as affecting local and foreign trade; much tabulated matter of importance following. This chapter by Mr. Harrod, with a few additional notes and references, would make a useful booklet for business men, the clear, concise and exact style being an important consideration.

Chapter VII, "The Effects of War," pp. 73-86, offers some difficulties, owing to the two senses in which the term war is understood by Mr. Appleton's helpers, (1) International Fighting; (2) Strife between Capital and Labour. It is, however, tolerably evident that in most cases our summarist soon breaks away from the bonds, and expresses his own view; also, as far as we grasp his view, it is that (1) and (2) are fundamentally similar. The danger of any such view appears to rest in an ultimate expression which may put private disputes into parity with inter-state warfare.

Mr. Appleton tells us that remedies for both aspects of warfare are similar, and he illustrates this by reference to the great dispute in the coal industry; "humanity," "ethical education," also other virtues of like kind, leading to arbitration rather than fighting.

MOUSEION. Bulletin of the International Institute of Intellectual Co-operation. April number. Paris. 16 francs.

The museum staffs of the world form, as it were, a cadre of civilisation. They are mostly not well paid for their services, which are not on that account given grudgingly.

There has always been less rivalry of a hostile kind in the intellectual field than in any other, but the Institute of Intellectual Co-operation is not superfluous. *Mouseion*, which appears three times a year, in April, September and December, should be welcomed as providing a voice for that body of men of learning and taste the weight of whose prestige is the measure of the community's enlightenment.

Mouseion has the agreeable format, feel and appearance of a high-class French review. The contents of the April number range from descriptions of museums in places so far apart as Cardiff and Albania to analyses of methods for subjecting pictures to scientific examination. There are four main heads: *La vie des Musées*, *la technique des Musées*, *les catalogues des Musées*, and a report of the proceedings of the *Office International des Musées*. The articles are illustrated by eight plates.

One of these shows the experiment on artificial lighting that is being made by the Ryksmuseum at Amsterdam. The picture chosen for the purpose is Rembrandt's so-called *Night Watch*. Here is a proper setting for a masterpiece, and an example to be followed. The most famous, the noblest picture in Belgium is crowded into the corner of a church, barricaded by a stall laden with photographs of itself, so placed that one half of the panels are bathed in sun while the other half are plunged in shadows, and finally, is the subject of a kind of abbreviated lecture in a bewildering succession of tongues.

M. André Blum's article on the scientific examination of pictures is most interesting, though, as he says, science cannot go so far as to give the critic "*des solutions toutes faites et définitives*." Before the seventeenth century it was the rule for painters to know the chemistry of their technique. Certain fine qualities are hardly to be expected in the work of artists who rely too much on their colourman.

There is an interesting note under the heading of the U.S.S.R. There are now

six hundred small museums in Russia made up of accurate copies of works of art, which are produced in Leningrad under the supervision of the *Direction générale des Sciences*.

CATALOGUES OF WALL PAPERS. Victoria and Albert Museum. 3s.

Not only is this catalogue illustrated, it also contains an introductory historical essay by Mr. C. C. Oman, in which the evolution of wall papers is most interestingly described.

Like mankind, wall papers do not progress with any inevitable steadiness. They too have had their ups and downs. Owing to their recent "down" they have been in disgrace with the mass of less affluent people of taste, who have blotted them out with distemper. But there are signs of a renaissance. Artists are again applying their talent to making designs for wall papers as for everything else that pertains to the machine-produced interior.

Among the most agreeable of these contemporary designs are direct imitations of marble, for use, admittedly, in a sophisticated environment. Now, as Mr. Oman says, "at no time has the inspiration of wall-paper been entirely original." At first textiles and wall paintings were imitated; later, sculpture, stucco-work and panelling; later again, leather-work. Technical limitations were by no means artistic limitations; indeed, it is only when technical progress had outstripped workmanship that there came that "orgy of complicated designs," the litter from which has not been cleared up to this day.

"The Gothic revival must bear the blame for the production of some of the most offensive designs"; but some of the early "original" designs for nursery paper were no better. "If the artistic taste of children can be ruined in the nursery, a paper such as No. 66 (V. & A.) . . . must be held responsible for many intellectual murders." The tide turned again in the sixties, when the influence of William Morris began to be felt in this as in other departments of craftsmanship.

An amusing sidelight on the seventeenth century is offered by a quotation from a letter from the Bishop of London to the Warden and Masters of the Stationers' Company, in which the Bishop requires them to " . . . Damask or obliterate whatsoever Sheets you have seized of a book called Leviathan . . ." Damasking was printing designs: in fact the usual way of dealing with censored books in those days was to turn them by damasking into wall papers or box linings.

Mr. Oman discusses both French designs and those Chinese papers for which there was a strong taste in England from about 1740 till about 1790. By this time Réveillon and others had brought the art of colour printing with wood blocks to perfection; and what with heavy customs duties and the vagaries of fashion to contend against, the Chinese papers disappeared from the market.

NATIONAL PROGRESS OF PERU.

In the introductory remarks to his Report on the Commercial, Economic and Financial conditions in Peru, H.M. Consul at Callao states that after a century as an independent nation, marked by revolutions, disturbances and international strife, Peru has suddenly emerged from this fluctuating existence, and, standing at the threshold of a new era, now commands attention as one of the coming republics of South America. The recent recognition of her national rights accorded to her by the International Plebiscitary Commission at Arica, in connection with her long-standing dispute with Chile, has served to emphasise her status. It is almost

incredible to those who knew the country before 1920 what progress has been achieved in the last few years under a stable government and a uniform political administration dedicated to a definite plan of national rehabilitation. With the rights of property guaranteed, and respect for those rights enforced, public confidence has been restored, and the nation as a whole has rallied to the support of the government in the realisation of its constructive programme.

New highways have been built, new buildings erected; new mines and oil wells opened up; new irrigation works and new railways commenced; new industries started; at the same time agriculture has been stimulated, national defence improved, and the health and general well-being of the people provided for by new sanitation works in most of the principal cities. Yet these improvements have not been brought about without considerable cost, and there are many who think that they have been undertaken on too great a scale in proportion to the wealth of the nation, and at too fast a pace in relation to its means and capacity to pay. The public debt has more than doubled in the last five years, and indirect taxes, either in the form of import dues or consumption duties, bear heavily on the people. There are few articles of common consumption, even though of domestic origin, such as matches, sugar, salt, tobacco, gasoline and beer, that do not include in their selling price a heavy proportion of public tax; and almost all imported articles, including wheat, flour, rice, and other necessities of life, are similarly subject to heavy customs duties. There is scarcely any article of commerce in Peru or any enterprise that is not made to pay its toll to the Government, and new schemes are constantly being sought for the creation of further revenues to keep pace with increasing expenditure. At such a rate the point of exhaustion must soon be reached, especially in relation to the poorer classes, and other means of raising revenue sought, or else expenditure curtailed.

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

MONDAY, OCTOBER 14. Automobile Engineers, Institution of, at the Royal Technical College, Glasgow. 7.30 p.m.
Prof. W. Morgan, "The Member and the Institution."
Brewing, Institute of, at the Charing Cross Station Hotel, Strand, W.C. 7.45 p.m. Messrs. E. B. Collier and F. E. B. Moritz, "The Season's Malts (made from 1928 Barleys)."
Heating and Ventilating Engineers, Institution of, at the Borough Polytechnic, Southwark, S.E. 7 p.m. Mr. F. F. Powell, "Vacuum Cleaning."
Transport, Institute of, at the Institution of Electrical Engineers, Savoy Place, W.C. 5.30 p.m. Sir Josiah C. Stamp, Presidential Address.
University of London, at Birkbeck College, Bream's Buildings, Fetter Lane, E.C. 5.30 p.m. Prof. L. L. Schücking, "Puritan Traits in English Civilisation." (Lecture I).
At Bedford College for Women, Regent's Park, N.W. 4.30 p.m. Prof. Geyl, "The Revolt of the Netherlands." (Lecture I).
At University College, Gower Street, W.C. 5 p.m. Dr. R. J. Brocklehurst, "Secretion of the Digestive Juices." (Lecture I).
At King's College, Strand, W.C. 5.30 p.m. Dr. Prof. A. Hevesi, "Great Figures of Hungarian Literature." (Lecture I).
At King's College, Strand, W.C. 5.30 p.m. Rev. G. E. Newson, "The Church and the World." (Lecture II).
At the London School of Hygiene and Tropical Medicine, 57 Torrington Square, W.C. 6 p.m. Prof. Dr. T. J. M. Madsen, "Seasonal Variations of Epidemic Diseases."
At University College, Gower Street, W.C. 2 p.m.

Prof. J. E. Neale, "England in Shakespeare's Day." Lecture I.—"Elizabeth and Her Court."
At University College, Gower Street, W.C. 5.30 p.m. Prof. K. Fajans, "Chemical Forces and Atomic Structure." (Lecture I).
TUESDAY, OCTOBER 15. Arts, Royal Academy of, Burlington House, W. 4.30 p.m. Prof. Arthur Thomson, "Anatomy—The Trunk and its Bones and Muscles. The Surface Forms dependent thereon in Action and Repose."
Cradwick Public Lecture, at the Institution of Mechanical Engineers, Storey's Gate, S.W. 8.15 p.m. Mr. Arthur J. Martin, "Sewage and Sewage Disposal." (Lecture I).
Metals, Institute of, at 39 Elmbank (rescued), Glasgow. 7.30 p.m. Mr. H. H. A. Greer, Chairman's Address.
Philosophical Studies, British Institute of, at the Royal Society of Arts, Adelphi, W.C. 8.15 p.m.
Transport, Institute of, at the Institution of Electrical Engineers, Savoy Place, W.C. 5.45 p.m. Lecture by Mr. J. Pike.
University of London, at Bedford College for Women, Regent's Park, N.W. 10 a.m. Miss Johnson, "Uncle and Nephew in Old French Epic and Romance."
At Bedford College for Women, Regent's Park, N.W. 12 noon. Miss Ellis-Fermor, "The Rise of the Drama."
At Bedford College for Women, Regent's Park, N.W. 12 noon. Miss Tarrant, "History of Greek Philosophy."
At Bedford College for Women, Regent's Park, N.W. 2 p.m. Mr. H. V. Routh, "Victorian Poetry."
At Bedford College for Women, Regent's Park, N.W. 2 p.m. Prof. Spencer, "History of Chemistry."
At Bedford College for Women, Regent's Park, N.W. 3 p.m. Prof. Mackie, "The Study of Scottish History."
At King's College, Strand, W.C. 5 p.m. Dr. J. W. Pickering, "Blood Plasma and Platelets." (Lecture II).

At King's College, Strand, W.C. 5.30 p.m. Prof. Sir B. Pares, "Russian History to 1861." (Lecture I).
At King's College, Strand, W.C. 4.30 p.m. Rev. P. Dearmer, "Byzantine and Byzantine Art." (Lecture II).
At the London School of Economics, Houghton Street, Aldwych, W.C. 5 p.m. Prof. Dr. R. Thurnwald, "The Problem of Evolution in the Social Processes." (Lecture II).
At St. Thomas's Hospital Medical School, Albert Embankment, S.E. 5 p.m. Dr. A. St. G. Huggett, "The Physiology of the Foetus." (Lecture II).
At University College, Gower Street, W.C. 5.30 p.m. Prof. B. Ashmole, "Aim and Method in the Study of Ancient Art."

WEDNESDAY, OCTOBER 16. Arts, Royal Academy of, Burlington House, W. 4.30 p.m. Prof. Arthur Thomson, "Anatomy—The Essential Features of the Face, Head and Neck."

Microscopical Society, 10, Hanover Square, W. 7.30 p.m. Public Health, Royal Institute of, 37 Russell Square, W.C. 4 p.m. Dr. E. Graham Little, "The Health and Conditions of Work of Medical Students."

University of London, at Birkbeck College, Bream's Buildings, Fetter Lane, E.C. 5.30 p.m. Prof. L. L. Schücking, "Puritan Traits in English Civilisation." (Lecture II).

At Bedford College for Women, Regent's Park, N.W. 10 a.m. Miss Gouvenot, "John Keats."

At Bedford College for Women, Regent's Park, N.W. 4.15 p.m. Miss Ellis-Fermor, "Restoration Drama."

At King's College, Strand, W.C. 5.30 p.m. Prof. Dr. A. Hevesi, "Shakespeare in Hungary."

At King's College, Strand, W.C. 5.30 p.m. Rev. Canon C. Jenkins, "The Contribution of King's College to the Advancement of Learning during the Century 1829—1928." (Lecture II).

At King's College, Strand, W.C. 5.30 p.m. Dr. F. A. P. Aveling, "Personalism: A Psychological Approach to Reality." (Lecture II).

At the London School of Economics, Houghton Street, Aldwych, W.C. 6 p.m. Prof. Luigi Einaudi, "Taxation." (Lecture I).

At the London School of Economics, Houghton Street, Aldwych, W.C. 6 p.m. Lecture II on "Office Machinery."

At the London School of Hygiene and Tropical Medicine, 37 Torrington Square, W.C. 6 p.m. Prof. Dr. T. J. M. Madsen, "Milk Epidemics."

At the School of Oriental Studies, Finsbury Circus, E.C. 5.15 p.m. Sir E. Denison Ross, "Libraries in the Near East."

At University College, Gower Street, W.C. 5.30 p.m. Prof. K. Fajana, "Chemical Forces and Atomic Structure." (Lecture II).

At University College, Gower Street, W.C. 5.30 p.m. Mr. J. H. Helweg, "Copenhagen, Past and Present." (Lecture I).

THURSDAY, OCTOBER 17. Chadwick Public Lecture, at the Institution of Mechanical Engineers, Storey's Gate, S.W. 8.15 p.m. Mr. Arthur J. Martin, "Sewage and Sewage Disposal." (Lecture II).

Chemical Society, Burlington House, W. 8 p.m. (1) Messrs. H. Burton and C. K. Ingold, "The Modes of Addition to Conjugated Unsaturated Systems. Part II: The Reduction of Conjugated Unsaturated Acids by Metals Dissolving in Aqueous Media." (2) Messrs. C. T. Morgan and E. A. Coulson, "Synthesis of Anthracene Homologues. Part I: 2:6 and 2:7-dimethylanthracenes." (3) Mr. A. W. Chapman, "Dynamic Isomerism Involving Mobile Hydrocarbon Radicals. Part I: The Triarylbiphenylamides." (4) Messrs. T. M. Lowry and F. L. Gilbert, "Studies of Valency. Part XIV: An Optically-Active Tellurium Salt: p-tolylphenylmethyltellurium Iodide." (5) Messrs. T. M. Lowry and F. L. Gilbert, "Studies of Valency. Part XV: Optically-active p-tolylphenyltelluride." (6) Messrs. G. T. Morgan and E. A. Coulson, "Synthesis of Anthracene Homologues. Part II: 2:3:6-trimethylanthracene."

Constructive Birth Control and Racial Progress, Society for, Gt. Britain (Steinway) Hall, Wigmore Street, W.

8.30 p.m. Dr. Marie Stopes, "Birth Control To-day: Some New Methods and Experiences."

University of London, at Birkbeck College, Bream's Buildings, Fetter Lane, E.C. 5.30 p.m. Prof. L. L. Schücking, "Puritan Traits in English Civilisation." (Lecture II).

At Bedford College for Women, Regent's Park, N.W. 4.30 p.m. Prof. Eccles, "Montaigne." (Lecture II).

At Bedford College for Women, Regent's Park, N.W. 5.15 p.m. Prof. L. Abercrombie, "The Teaching of Literature."

At King's College, Strand, W.C. 5 p.m. Dr. J. A. Hewitt, "Metabolism of the Carbohydrates and Fats." (Lecture I).

At King's College, Strand, W.C. 5.30 p.m. Dr. Prof. A. Hevesi, "Great Figures of Hungarian Literature." (Lecture II).

At the London School of Economics, Houghton Street, Aldwych, W.C. 5 p.m. Prof. Dr. R. Thurnwald, "The Problem of Evolution in the Social Processes." (Lecture III).

At University College, Gower Street, W.C. 5.30 p.m. Prof. Neale, "The Elizabethan Parliament." (Lecture I).

FRIDAY, OCTOBER 18. Dyers and Colourists, Society of, Milton Hall, Deansgate, Manchester. 7 p.m. Dr. Tagliani, "The Application of the Locust Beans in the Textile Industry and especially in the Calico Printing Trade."

Electrical Development Association, British, at the Royal Society of Arts, Adelphi, W.C. 7.30 p.m. Miss G. Buriton, "Personal Salesmanship in the Electrical Industry."

Historical Society, 22 Russell Square, W.C. 5.30 p.m. Prof. F. M. Stenton, "The Danish Settlement of the Ninth Century and its Results."

Junior Institution of Engineers, 39 Victoria Street, S.W. 7.30 p.m. Mr. W. A. Willox, "Some recent French Railway Construction."

Mechanical Engineers, Institution of, Storey's Gate, S.W. 6 p.m. Dr. Daniel Adamson, "Presidential Address."

North East Coast Institution of Engineers and Shipbuilders, Bolbee Hall, Newcastle-upon-Tyne. 6 p.m. Mr. Launcelot E. Smith, "Presidential Address. Annual General Meeting."

Public Health, Royal Institute of, 37 Russell Square, W.C. 5 p.m. Prof. Dr. Rudolf A. Peters, "Co-ordinative Bio-Chemistry of the Cell and Tissues. Cell Surfaces with reference to the part played in the Integration of Cell Processes by Adsorption."

University of London, at King's College, Strand, W.C. 5.30 p.m. Prof. Dr. A. Hevesi, "Great Figures of Hungarian Literature." (Lecture III).

At King's College, Strand, W.C. 5.30 p.m. Prince D. S. Mirsky, "The Russian Drama." (Lecture I).

At King's College, Strand, W.C. 5.30 p.m. Mr. A. E. Stamp, "The Authenticity of the Disputed Revels Accounts."

At King's College for Household and Social Science, 61 Camden Hill Road, W. 5 p.m. Prof. H. V. Mottram, "Human Nutrition." (Lecture I).

At the London School of Economics, Houghton Street, Aldwych, W.C. 4.30 p.m. Dr. W. Ross, "German Life and Literature from the End of the Thirty Years' War." (Lecture I).

At the London School of Economics, Houghton Street, Aldwych, W.C. 5 p.m. Prof. Luigi Einaudi, "Taxation." (Lecture II).

At the London School of Hygiene and Tropical Medicine, 37 Torrington Square, W.C. 6 p.m. Prof. Dr. T. J. M. Madsen, "Diphtheria Toxin and Antitoxin."

At University College, Gower Street, W.C. 5.30 p.m. Prof. K. Fajana, "Chemical Forces and Atomic Structure." (Lecture III).

At University College, Gower Street, W.C. 5.30 p.m. Mr. H. J. Cohen, "The Origins of the Legal Profession in England."

SATURDAY, OCTOBER 19. L.C.C. Horniman Museum, Forest Hill, S.E. 3.30 p.m. Mr. D. Martin Roberts, "London in the Middle Ages."

JOURNAL OF ~~THE~~^{THE} ROYAL SOCIETY OF ARTS

No. 4013.

VOL. LXXVII.

FRIDAY, OCTOBER 18th, 1929.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.(2.)

THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO.*

By A. LENNOX STANTON,

M.I.Mech.E., M.I.E.E., M Amer.S.Mech E , M.I.E (India).

Isolated independent enterprise, tending to make electricity supply a communal luxury, is rapidly being displaced by a pioneer process or reorganization for the attainment of pooled or co-ordinated electricity supply systems. These are professedly designed to transmit and distribute energy under conditions of maximum utility within the areas of their application.

Now it is indisputably true that electricity is the most flexible of power agents in existence, and no limitation can be placed on its adaptability to meet the needs of man. Moreover, so rapidly is expansion taking place, correlatively with an ever-increasing demand for electricity as an established element of life, that the question of planning development on lines which permit of energy being delivered to the consumer at the lowest possible rates, has become of primary importance.

This position is largely the outcome of a world-wide recognition that electricity is a particularly potent means by which many limitations prevailing in both industrial and social life may be broken down. Its recognition is self-evident in Great Britain, through the joint labours of the *Electricity Commissioners* and the *Central Electricity Board*, nevertheless, the realisation that the full advantages which follow electrical development cannot come about until *organised* publicity is focussed upon the question of rates, finds a fuller expression on the other side of the Atlantic than is the case here.

An outcome of this activity to which particular attention may be drawn is the ability of electric utilities in America to place more power behind the

*Some notes on the labours of the Hydro-Electric Power Commission of Ontario. Address presented to the *Overhead Lines Association*, March 20th, 1929.—Reprinted from *World Power*, May, 1929.

industrial worker than is the case in other countries. Moreover, an increasing prominence is there given to propaganda claiming cheap power as the panacea for most of the commercial, industrial, and domestic burdens in life. It follows, *cheap* power is looked upon as a major asset in maintaining the prosperity of the American people, and an increasing activity prevails there, organised to combat any conditions which threaten to limit its availability.

Across the Canadian border a similar outlook is held, but in so far as the Province of Ontario is concerned, the system of development adopted differs fundamentally from that found in general operation throughout both the adjoining province of Quebec and in the United States. Ordinarily, the difference is contained within the meaning of all that is connoted by the terms private and public ownership, which means, in electrical undertakings, that not only do the financial objectives and limitations under which development is carried out differ, but also, that the objective relationship holding good between the supplier and the consumer differs too.

In the United States private ownership is the rule, and communities with electric service have to rely upon a system of what is termed "public regulation" for the availability, adequacy, and fairness of rates charged.

In Ontario public ownership is the rule, but at present, as will be shown later, in its administrative character, and more especially in its relationship to consumers through the medium of rate structure, it has no parallel anywhere in the world. The scope of its activities renders all communal development subject to the wide-spread powers of a special Power Commission Act, and responsibility for the carrying out of the expressed aims of the Act and for the proper administration of all that is called for thereunder is vested in a body corporate, known officially as *The Hydro-Electric Power Commission of Ontario*.

It needs but little thought to recognise that the success or failure of such an undertaking has a particular significance for the opponents of public ownership all over the world. To date, and even if judged by nothing more than the evidence of available published matter definitely opposed to what the Commission's constructive activities represent, it cannot be doubted that its labours have played a far greater and wider part than is commonly recognised, in that few, if any, assets of national life possess greater value than a cheap and abundant supply of electricity.

Purely commercial comparisons of the relative systems of development invariably ignore this all-important outlook, and by reason of attempts to build up comparative data, more or less favourable to the point of view only of either the investment holder or the large power consumer, rarely fail to present statements indicative of that limitation.

As the major portion of development methods in the United States are directly opposed in principle to those of the Ontario undertaking, it is not surprising to find *that the successful and continued expansion side of the latter undertaking* is referred to most frequently in the United States, by that section

of the public who are desirous of creating a demand there for a similar monopoly of electric power resources.

This has been provocative of highly organised opposition, in which a large amount of literature, inimical to the labours of the Commission, has found a prominent place. Undoubtedly creative of much confusion of issue and objective regarding the Commission's activities, this controversy has probably done more than anything else could have done to enlighten the minds of consumers regarding electrical matters. There now exists a situation in the United States which has in view the probing of the practical value of "public regulation" of rates, through a searching and critical inquiry into the administration of their own utility undertakings.

Now, it is true that the unusual water-power facilities which exist at Niagara make it possible to generate large amounts of electrical energy at that point at an exceptionally low cost, but the *whole* cost of generation is only the beginning of a straight line sequence of *total* cost terminating at a consumer's meter, and in the case considered here, possibly located on a farm more than two hundred miles distant from the point of generation.

Therefore, in considering what follows, it is well to remember that advances made in generating electricity by prime movers other than water have been no less rapid, and where favourable facilities exist for creating high-grade steam-operated plants, that the whole cost of generation may compare sufficiently favourably with the whole cost of hydro-electric generation at particular sites, so as to render any difference in this item of the total cost of delivering energy to consumers' terminals comparatively unimportant, when considering the question of a rate base.

It may be said that the conditions of electrical development applicable to Ontario and Great Britain are too diverse in character, both in conditions of application and in function, to admit of any constructive comparison, but is such a statement correct?

Its truth, or otherwise, can only be ascertained from a consideration of fundamentals, probably related to basic elements in development, which are independent of locality in their effect upon rate bases; and this only when the fundamentals are stripped of complications common to the realms of financial manipulation and accounting.

Where in the world can be found a similar area so richly endowed as Great Britain with the natural resource COAL, together with such wonderful facilities for cheap and rapid transport by land or water? Where can be found a similar area wherein so colossal a waste has been recorded, and wherein so great a confusion of issue is presented, when viewed (as it should be) from the standpoint that coal represents the same asset to this country as water does to Ontario?

Moreover, since limitation of sites, which make the costs of generation vary widely under hydro-electric developments located far apart, do not

apply to large modern steam plants, it is clear that, if the best natural conditions here were properly developed and correlated throughout the whole country, the forced dependence upon steam plants could be turned to positive advantage for the stabilization of rates uniformly conducive to the use of electricity on scales calling for many changes in present methods. Nor, in this connection, is it to be overlooked that the major hydro developments of Ontario are necessarily located far less favourably than are the steam-raising facilities of this country. Witness power now being transmitted to the Niagara system from a point of generation in the Province of Quebec.

THE ORIGIN OF THE HYDRO-ELECTRIC POWER COMMISSION.

Primarily, Canada is an agricultural country, but each year that passes indicates the attainment of proportionately greater industrial importance. Under present conditions, the most intensive areas of development lie within the Provinces of Quebec and Ontario, where the proximity of the United States across a common waterway has had a profound influence upon industrial effort.

Of the two Provinces named, Ontario is well known as the chief manufacturing area of Canada. In addition to this, and its extensive agricultural, dairy, and lumber interests, Ontario produces ninety per cent. of the world's supply of nickel, holds the third world-position for gold production, produces silver and copper on an increasingly extensive scale, and, as a producing Province, accounts for more than one-third of the annual production of Canada. With a population of barely three millions, of whom approximately one-third dwell in what would be termed rural areas in this country, its area exceeds three and a quarter times the square mileage of the entire British Isles.

Perhaps it is well to point out here that the foregoing facts and the preceding introductory remarks are necessary to a proper comprehension of the degree to which the industrial and social life in Ontario is bound up with the advantages derived from the availability of a plentiful and cheap supply of electricity.

As will be shown later, this all-important aspect of the general activity is not wholly attributable to the uses to which natural resources not available elsewhere have been put, but is equally reflective of an ability, on the part of the people themselves, to create conditions whereby natural resources might be developed and utilised in the fullest possible measure for the greatest common advantage.

This ability forms the response to a spirit of common endeavour in the development of conditions designed to place the advantages of electricity within the reach of all living within well-defined areas of economic accessibility: this, moreover, even to the extent of providing for that section of the community which, otherwise labouring under conditions of maximum drudgery

and hardship, is *individually* least able to pay for the full initial cost of its availability.

It is educational to consider how this rare state of affairs has come about.

At the beginning of the present century, it had dawned upon the minds of those gifted with foresight that the Province of Ontario was so blessed with potential resources and possibilities for industrial effort, that every incentive existed for furthering its advantageous development. The greatest apparent obstacles were two-fold: the first was contained within the undesirable dependence of the Province upon extraneous sources for its supplies of fuel; the second, of a mental order, necessitated the awakening of the people to a recognition of the development possible through and by organised effort having a common objective.

As an offset against the serious physical deficiency in fuel resources, there were well-recognised possibilities for developing hydro-electric power, of which the Falls of Niagara formed by far the largest and most attractive proposition. Supplementing this recognition existed a keen spirit of inquiry into the possibilities of electricity, not only as an aid to industrial development, but also as a most valuable adjunct in raising the general standard of life throughout the Province.

The outcome of this public interest was a strong demand for legislation to enable municipalities to take such concerted action as would provide for adequate supplies of electrical energy being available at as low a cost to the consumer as possible. In 1903 the Government of Ontario provided the means for the formation of a Commission to investigate and report upon all questions involving the generation, transmission, and distribution of electricity in the Province.

The report was completed and published in 1906, during which year the Provincial Government, by a special Act, provided for the creation of the Hydro-Electric Power Commission of Ontario. Such in brief was the original material out of which has arisen the extensive undertaking of to-day.

In 1908 the Commission, acting on behalf of the municipal and other interests served, decided to purchase power in bulk, and, building its own transformer stations, distribute the purchased energy. Its initial load was less than one thousand H.P.; in 1915 the Commission had reached the limit of its contract for 100,000 H.P. with the Ontario Power Co., and in 1917 purchased that Company's plant outright, followed in 1920 by the purchase of plant owned by the Toronto Power Co.

PHYSICAL GROWTH OF THE UNDERTAKING.

Subsequent growth is shown by the figures which follow here, indicating how the distribution of power generated and taken over a twenty-minute-peak period in December, 1927, was allocated over eight distribution systems:

	System.	Horse power.
Niagara		853,960
Georgian Bay		21,791
St. Lawrence		9,033
Rideau		3,123
Thunder Bay		42,332
Ottawa		18,794
Central Ontario and Trent		47,994
Nipissing		3,225
Total H.P.		1,000,252

During the fiscal year 1926-27 the total
output in KWh. was 3,904,432,004
Adding KWh. purchased, representing .. 201,802,454

The total undertaking output for year 1927 was 4,106,234,458

Overhead line-work finds a full scope by reason of a phenomenal expansion, under what necessarily included a considerable period of pioneer practice. Apart from power requirements covered by block purchase, the eight systems connect up twenty-two hydro-electric generating plants ranging in normal operating capacity from 428 H.P. at Carleton Place to 522,790 H.P. at Queenston, Niagara. Of these eight systems, seven transmit under 60-cycle conditions, while the eighth, Niagara, transmits at 25 cycles

At the end of October, 1927, over 3,350 miles of transmission line alone was in service, operating under eleven line pressures, ranging from 12,000 to 110,000 volts; the greatest length of continuous 110,000-volt line in service forming a stretch of approximately 240 miles. On the 1st of October, 1928, delivery of 25-cycle power to the Commission by the Gatineau Power Co., located in the Province of Quebec, for use on the Niagara system, was inaugurated under a contract which calls for the transmission of an ultimate load of 260,000 H.P. over a distance of 230 miles, at a line pressure of 220,000 volts.

During the year under review, and dealing with energy delivered to municipal areas, advantage was taken of available supply by 433,128 consumers out of a population numbering 1,631,149. The Niagara system supplied approximately 84.8 per cent. of the total consumers under this head, and the distribution of energy over the whole of ten municipal systems was as follows:

- (a) Twenty-four cities, each having a population of not less than 10,000; about 80 per cent. of the energy distributed was utilised by this group, numbering 324,534 consumers in a population of 1,247,804.
- (b) Fifty-eight towns, each having a population of between 2,000 and 10,000; about 12 per cent. of the energy distributed was utilised by this group, numbering 67,980 consumers in a population of 267,701.
- (c) One hundred and twenty small towns, villages, and rural areas, each having less than 2,000 inhabitants. The area served here embraces 35,244

consumers in a scattered population of 115,644, which is augmented by 5,370 consumers resident in 48 Police Villages, making the total number of consumers up to 40,614. At present this group utilises less than 10 per cent. of the energy distributed, but legislative measures designed to secure that supply service should be available for meeting its needs have been given a very definite place in the Commission's activities.

FINANCIAL POSITION.

Turning now to the financial position of the undertaking, it should be noted that all monetary values which follow hereafter have been translated into approximate sterling equivalents, on the basis of 4.866 dollars to the pound sterling and 2 cents to the penny.

The accounting year 1927 (which forms the latest available completed annual return), shows the total investment of the Commission to date, represented by power undertakings, hydro-electric railways, municipalities in distributing systems, and other assets to exceed £58,809,031. In the same year (1927) the total aggregate revenue derived from this capital investment exceeded £6,998,912, and the Commission reported that the revenue obtained from the consumers had been more than sufficient to meet the full cost of generating and transmitting the electrical energy, as well as to provide for all operating expenses and the fixed charges of the municipal utility equipments.

Year by year, too, the reserves of the undertaking have been steadily increasing, both with respect to the collective investments of municipalities in generating stations, transmission station and transmission lines, also with respect to their local investments in distributing systems and other assets. At the end of October, 1927, the aggregate reserves reached £13,447,295.

Respecting the cost to the ultimate consumer of electricity furnished to municipalities by the Commission, an inspection of available data for the year ending October 31, 1927, and subsequently received, reveals the following striking features :

- (i) The average annual consumption per *domestic* consumer over the entire Province reached the high figure of 1,242 units, delivered at an average cost of 0.9 pence equivalent per unit.
- (ii) The area of *highest* communal density located at the greatest distance from a generating station (a matter of 238 miles) received its supply from the Niagara system. With a population of 56,433, the domestic consumers numbered 13,742, and the average monthly consumption under this service was 189 units, delivered at a net cost of 0.8 pence equivalent. Power service consumers in the area numbered 366, and the average cost per H.P. per year was approx. £5.238 equivalent.
- (iii) The area of *lowest* communal density located at the greatest distance from a generating station (a matter of 267 miles) also received its supply from the Niagara system. With a population of less than 2,000

- the domestic consumers numbered 177, and the average monthly consumption under this service was 71 units, delivered at a net cost of 1.55 pence equivalent. Power service consumers in the area numbered 6, and the average cost per H.P. per year was approx. £6.935 equivalent.
- (iv) The lavish use which is being made of electricity by domestic consumers was shown by the increase of over 16 per cent. in consumption over the previous year, representing an increase in the domestic demand of over 65 million units.
- (v) Checks of domestic service data, furnished for a period commencing with the year 1914 and terminating in 1927, show a steady reduction to have taken place in the average cost per kilowatt-hour, but that a point has been reached in the lowest levels now operative, below which it is unlikely they will fall. The high average consumption under this head is attributed chiefly to the policy followed by the undertaking, in providing electricity "at cost," which is supplemented by facilities under rate schedules, designed to encourage a liberal use of the service.
- (vi) Indicating the trend of power application and more particularly as relating to domestic consumers, it is interesting to note that more twenty-five ampere, three-wire meters are sold in Ontario than any other size, and that Canadian meter practice limits the smallest size single-phase meter to ten amperes. The extent of the growth in power consuming devices is shown by the following table :

Application.	Estimated Number in Use.		Estimated Installed Capacity in KW.	
	Dec. 1924	Dec. 1927.	Dec. 1924.	Dec. 1927.
Ranges	47,505	83,298	285,030	499,788
Hot plates	18,883	34,178	37,766	68,356
Washers	55,342	92,219	11,068	18,443
Vac. cleaners	64,205	88,539	12,841	17,707
Water heaters	16,665	32,211	25,000	48,316
Air heaters	130,000	131,531	82,400	105,225
Ironers	1,590	2,403	4,770	7,209
Irons	307,800	363,476	203,148	239,894
Refrigerators	657	11,176	130	2,235
Toasters	152,200	171,317	83,710	94,224
		Total ..	745,863 KW.	1,101,397 KW.

- (vii) Development in rural areas proves it to be of increasing importance, and the manner in which this difficult class of service is being dealt with bids fair to rank as an outstanding feature of the Commission's activities.

RURAL SERVICE.

Having travelled thus far, now turn to the rural line side of the Commission's labours. At the present time, the Commission is operating 130 rural power districts in different parts of the Province, a typical district covering about 100 square miles, which is governed in respect to area by the economic limitations presented through proximity to suitable distribution centres served from a transmission line.

Recognising that the cost of distributing small quantities of power in rural districts necessitates rates which are considerably higher than the rates in urban centres, where consumers are located more or less close together, the Provincial Government, as far back as 1921 and in fulfilment of its policy of promoting the basic industry of agriculture, decreed an Act to provide aid in the construction of works in rural power districts.

Under the present statutory obligations, wherever the economic conditions are deemed by appointed authorities to justify rural district service, it is enacted that the Provincial Government may pay out to any properly recognised distributing authority "a sum not exceeding fifty per centum of the capital cost of constructing and erecting in the rural power district, primary transmission lines and cables, service transformers and meters and secondary lines on the highway required for the delivery of power in such rural power district."

The experience gained by the Commission to date is such as enables electrical service to be given to rural districts when there can be secured three signed farm contracts, or their equivalent, per mile of line to be constructed.

The rates *first* submitted to the prospective consumers therefore constitute a maximum, and these may be, and in practice frequently have been reduced, as the number of consumers per mile of line constructed in the district increase above the required minimum. Having made its grant-in-aid, the Government's participation in operations respecting the property to which the grant applies ceases.

In their annual rates the rural consumers pay the whole of the cost of power as delivered to the boundary of the rural power district; the whole of the operating and administrative expenses chargeable to the rural power district; the reserves for renewals and contingencies on the whole of the transmission lines and equipment, as well as interest and sinking fund applicable to half the capital investment for the primary and secondary lines and equipment.

As applies to all other public services throughout the undertaking, service given by the Commission is always advised as *at cost*, and rate or tariff schedules are formulated on that basis. Should, however, a greater use be made of the service than was anticipated, a greater revenue will result without proportionate increase in expenses, and therefore a greater surplus will also result. This has been the experience of the Commission in connection with the operation of rural power districts, and during the year under review (1927) the Commission returned approximately £47,266 equivalent in cash to rural consumers, which

amount had been collected in excess of the actual cost of service in the various rural power districts.

The present capital investment in rural lines and equipment now exceeds one and three quarter million pounds equivalent, and the growth of service between the years 1923 and 1927 was as follows :

Year.	Miles of Primary Line.	Number of Consumers.			Power Supplied.
		Hamlet.	Farm.	Total.	
1923	1,058.59	4,158	3,822	7,980	3,514 H.P.
1927	2,921.78	15,526	9,757	25,283	13,273 H.P.

UNDERLYING PRINCIPLES OF THE COMMISSION'S ACTIVITIES.

Brief and incomplete as this limited review of the Commission's activities necessarily must be, nevertheless, it should suffice to create an interest in governing principles, conceived of and believed in by its inaugurators, which, originally adopted and subsequently modified to meet the necessities of experience, underlie and consolidate its labours

Primarily, the declared function of the Commission is one of using its best endeavours to secure an adequate and reliable supply of electrical energy for the people of Ontario at the minimum cost to the consumer consistent with the financial stability of the enterprise. In labouring to attain this difficult objective, while the Commission generates and transmits energy in much the same way as a wholesale manufacturer may who also runs his own selling business, it also acts in the capacity of Trustee for the partnership of municipal authorities co-operatively organised to obtain power at cost, each authority paying its due proportion of the cost for the service rendered. Each authority then sells electrical energy to its own local consumers at rates and under conditions approved by the Commission.

Moreover, the dual responsibility which devolves upon itself as " Supplier " and to the " Consumer " as the source of revenue, under the special relationship here holding good between the financial structure and consumers' rates, is such as not only to provide for meeting all the usual fixed charges included thereunder, but also to provide—

- (a) For effecting such rate adjustments between the various classes of service as may be found necessary to ensure that, as nearly as is practicable, the service to each class and to each consumer shall be at *cost*.
- (b) For the people themselves ultimately becoming owners of a fully paid up local undertaking.

The Commission also acts as a purchaser of material for all municipalities desirous of the advantages such a course affords, and otherwise aids consumers through the medium of an extensive publicity organisation. Furthermore, all

electrical equipment it is proposed to connect up on a service must receive the approval of the Commission's inspection department before use ; also, all indoor wiring and all completed installation work is subject to a compulsory inspection, this being the rule throughout Ontario.

CONCLUSION.

In conclusion, special attention is drawn to twelve appendices containing supplementary data deemed to be of interest.

Bearing in mind the defined objects of the Overhead Lines Association, and having particular reference to the one which reads as follows :

"To assist in making available with reasonable promptness, in every home throughout Great Britain, an abundant supply of electricity, and generally to adopt any course of action that the members may consider beneficial, and particularly by facilitating the erection of overhead lines, which are the only economical means of achieving that object in areas not very densely populated,"

it will be clear that a purely constructive review of the Commission's activities should possess a special interest for its members.

This granted, perhaps it is opportune to remind members here that no other pioneer labour finding active expression in this country at the moment *has quite the same objective* as that implied by the foregoing.

As defined, this objective would appear to classify the O.L.A. as a consumers' advocate ; nevertheless, I suggest its fulfilment cannot well become a reality until the fundamentals of both cost and rates are thoroughly investigated.

Finally, I have to express my indebtedness to F. A. Gaby, D.Sc., Chief Engineer of the Commission ; to various other Staff Officers of the Undertaking and to William C. Noxon, Esq., the Agent-General for Ontario in this country, for permission to draw upon returns, and to make extracts from both communicated and published data relative to the subject.

APPENDIX I.

TABLE I.

Domestic Service Data for all Municipalities.

Year.	Number of Consumers.	Average Monthly Consumption (KWh.).	Average Cost per KWh.	
			Cents.	(Pence Equivalent.)
1914	64,866	21.0	5.08	2.54
1920	193,892	44.6	2.56	1.28
1923	286,858	75.7	2.04	1.02
1927	387,573	103.5	1.80	0.90

TABLE II.
Commercial Lighting Service Data for all Municipalities.

Year.	Number of Consumers.	Average Monthly Consumption (KWh.).	Average Cost per KWh.	
			Cents.	(Pence Equivalent.)
1914	15,657	90.8	4.00	2.00
1920	36,496	140.0	2.50	1.25
1923	46,383	195.6	2.46	1.23
1927	64,039	266.7	2.40	1.20

TABLE III.
Street Lighting Service Data for all Municipalities.

Year.	Wattage of Street Lamps in Use.	KWh.	Average Cost per KWh.	
			Cents.	(Pence Equivalent.)
1925	15,100,000	61,910,000	2.28	1.140
1926	15,114,000	61,987,000	2.35	1.175
1927	16,003,305	65,613,550	2.37	1.185

APPENDIX II.

TABLE IV.
Power Service Data for all Municipalities.

Year.	KWh.	Average Cost per KWh.	
		Cents.	(Pence Equivalent.)
1925	160,031,150	1.06	0.53
1926	177,362,002	1.06	0.53
1927	186,247,165	1.00 *	0.50

TABLE V.

Commercial Power Service Data for all Municipalities and Private Power Consumers of the H.E.P.C.

Year.	KWh.	Average Cost per KWh.	
		Cents.	(Pence Equivalent.)
1925	1,634,409,666	0.61	0.305
1926	1,879,029,286	0.60	0.300
1927	1,933,491,298	0.60	0.300

APPENDIX III.

TABLE VI.

Showing the relation between development and rates in the city of Windsor, population 56,433, area of highest communal density located at the greatest distance from a generating station, a distance of 238 miles.

(a) Domestic Service.

Year.	Number of Consumers.	Average Monthly Consumption. (KWh.).	Net Cost per KWh.	
			Cents.	(Pence Equivalent.)
1915	2,519	18	4.9	2.45
1916	3,180	21	4.9	2.45
1917	3,882	26	4.5	2.25
1918	4,415	27	4.2	2.10
1919	5,383	31	3.9	1.95
1920	8,700	53	3.2	1.60
1921	9,731	51	3.0	1.50
1922	10,450	68	2.6	1.30
1923	12,021	94	2.2	1.10
1924	11,263	125	1.9	0.95
1925	12,382	159	1.7	0.85
1926	13,464	177	1.7	0.85
1927	13,742	189	1.6	0.80

APPENDIX IV.
TABLE VI (*continued*).
(b) *Power Service.*

Year.	Number of Consumers.	Average H P	Average Cost per H.P.	
			Dollars	Approximate Sterling Equivalent.
1917	97	807	19.04	£3.913
1918	101	1205	22.88	4.702
1919	136	1609	24.53	5.041
1920	273	5549	28.28	5.812
1921	341	6169	23.78	4.887
1922	321	6958	30.96	6.362
1923	311	7342	33.53	6.891
1924	335	8015	36.09	7.417
1925	350	7988	34.55	7.101
1926	351	8405	32.13	6.603
1927	366	8477	25.49	5.238

APPENDIX V.
TABLE VII

Further examples showing the relation between development and rates in municipal areas *not* served from the Niagara system

1. The city of Ottawa, population 118,697, distance from generating station, one mile

(a) *Domestic Service*

Year.	Number of Consumers	Average Monthly Consumption (KWh)	Net Cost per KWh	
			Cents	(Pence Equivalent)
1914	6,342	19	5.0	2.50
1915	7,338	22	3.8	1.90
1916	7,912	23	3.4	1.70
1917	8,636	24	3.4	1.70
1918	9,047	31	2.3	1.15
1919	8,976	45	2.0	1.00
1920	9,451	53	1.8	0.90
1921	9,955	67	1.6	0.80
1922	10,493	93	1.4	0.70
1923	11,050	122	1.1	0.55
1924	11,022	139	1.1	0.55
1925	11,155	151	1.1	0.55
1926	11,217	179	1.0	0.50
1927	11,365	205	0.9	0.45

APPENDIX VI.
TABLE VII (*continued*).
(b) *Power Service.*

Year.	Number of Consumers.	Average H.P.	Average Cost per H.P.	
			Dollars.	Approximate Sterling Equivalent.
1917	204	3553	17.72	£3.642
1918	207	4743	13.63	2.801
1919	205	4401	14.37	2.953
1920	210	4531	13.61	2.797
1921	228	4910	12.90	2.651
1922	229	5135	13.00	2.672
1923	240	5410	14.62	2.984
1924	243	5762	13.72	2.820
1925	207	5703	14.40	2.960
1926	200	5747	14.38	2.956
1927	200	6105	14.63	3.007

APPENDIX VII.
TABLE VII (*continued*).

2. The city of Owen Sound, population 12,339, distance from generating station, 32 miles. System, Georgian Bay.

(a) *Domestic Service.*

Year.	Number of Consumers.	Average Monthly Consumption (KWh.).	Net Cost per KWh.	
			Cents.	(Pence Equivalent.)
1918	1,492	17	5.1	*2.55
1921	2,075	28	3.8	1.90
1924	2,548	53	2.1	1.05
1927	2,846	68	1.8	0.90

(b) *Power Service.*

Year.	Number of Consumers.	Average H.P.	Average Cost per H.P.	
			Dollars.	Approximate Sterling Equivalent.
1918	84	1177	27.25	£5.600
1921	109	1403	20.75	4.264
1924	108	1385	21.41	4.400
1927	110	1632	16.82	3.456

APPENDIX VIII.

TABLE IX.

Under *power service* (see *Twentieth Annual Report*) illustrates variations in the average cost per H.P. on selected areas of the Niagara system ; also the *maximum* costs applicable to this service on some other systems of the undertaking.

System Number.	Locality.	Distance from Generating Station (Miles).	Total Consumers.	Power Consumers only.	Average H.P.	Average cost per H.P.	
						Dollars.	Approx. Sterling equivalent.
1	Niagara Falls	1	4,824	83	3,546	21.96	£4.513
1	Chippawa	4	290	5	101.	57.61	11.840
1	St. Catharines	18	6,038	125	4,688	15.88	3.264
1	Guelph ..	75	5,488	118	5,725	18.47	3.795
1	Brampton ..	78	1,552	53	813	18.71	3.845
1	Ayr ..	84	226	4	44	22.65	4.655
1	London ..	123	18,773	495	18,278	20.87	4.290
1	St. Marys ..	133	1,217	42	883	25.21	5.181
1	Ailsa Craig ..	148	165	2	48	36.48	7.497
1	Chatham ..	193	4,517	116	2,991	24.98	5.134
1	Sarnia ..	205	4,591	77	3,510	34.85	7.162
1	Windsor ..	238	16,070	366	8,477	25.49	5.238
1	Alvinston ..	267	207	4	62	44.01	9.044
2	Arthur ..	63	223	4	51	44.30	9.104
3	Lancaster ..	25	104	1	3	57.94	11.907
4	Kemptville ..	62	349	6	113	40.80	8.384
5	Port Arthur ..	73	4,598	85	34,478	20.52	4.217
7	Bloomfield ..	29	166	9	104	35.24	7.242

For system reference note as follows :—

No. 1 Niagara. 2. Georgian Bay. 3. St. Lawrence. 4. Rideau.
5. Thunder Bay. 7. Central Ontario.

NOTES ON BOOKS.

THE BRITISH EMPIRE SINCE 1783. By A. P. Newton and J. Ewing. London : Methuen and Co., Ltd. 5s.

This is a very useful little book. The British Empire, like all things that are immense—like sky-scrapers and the number one million—is hard for the ordinary person to understand. Besides, the Empire is not a simple, vast mass, like Russia and Siberia, but a number of different countries with varying constitutions and habits. To most Londoners the Highlands of Scotland seem remote ; how much more remote the Highlands of New Zealand or the west of Canada.

It needs more than the familiar kind of patriotism to make us feel warmly about the Empire, and it is not as if the Dominions " belonged " to us, thus allowing us

to enjoy any sense of possession, however diluted. Pride in the Empire is conditional on a more complex sense of values than pride in the busbies of the Guards.

In the first place, it is true that the Empire was made by men from our small home islands who faced and overcame the most alarming perils in their determination to plant the flag firmly in the four quarters of the globe. But apart from the personal qualities that it demands, the business of building empires is not always more respectable than the business of founding great families; in the case of our own Empire, we can be thankful that the lesson of the years round about 1780 was not forgotten, and that since then British Imperial policy has increasingly shown respect for Reason.

Politically, economically and culturally, the Empire ought to have a future more thrilling even than its past. The part the imperial race has the chance of playing in the diffusion of western civilisation is an important one indeed. Cut off from the European mother country, the Dominions would have a far harder task to carry on the humanistic traditions of the Old World, than if linked with her by ties of sound sentiment and intelligent economics. Man does not live by bread alone, nor new countries by their physical resources.

But we cannot study the future. We can study its roots in the past and present, and a good means of our doing so, where the Empire is concerned, is the text-book offered to us by Messrs. Methuen. The facts are presented without varnish, which is good. Statistics have a glamour of their own, and perhaps a more civilised appeal than the recital of daring deeds.

Great Britain is overcrowded, but the Empire is underpopulated. The problem of emigration can never be given up till it is solved. Must we, in peace as in war, waste our human resources?

Here are some of the facts and figures. Let us hope that before long someone will come forward with the Ideas.

PRACTICAL STEEL MAKING. By Walter Lister. London: Chapman and Hall, Ltd. 25s.

The author of this book states in his preface that he has been for many years impressed by the lack of literature and information of practical value available for the man who is going to work the furnace. After all, as he says, he is the main factor contributing to the success or otherwise of any modern steel works undertaking. Without his intelligent co-operation the best of theoretical intentions go astray. Accordingly he has written this book in a simple and concise form, giving the results of over twenty years' experience of practical steel making in most of its various branches and methods. He has not gone fully into such aspects of the subject as details of construction, lay-out of plant, costs, etc. This has been done many times already. He has dealt simply with the essential aspects that come under the direct control of the steel maker. It is not to be expected that all his views will be accepted: some of them will no doubt be criticised; but it must be remembered that the book is the first of its kind, and that it is very much needed.

It deals mainly with the acid and basic open-hearth process, and this is as it should be, because by far the greater part of the steel which is manufactured at the present time is made by one or other of these processes. We are glad to notice, however, that electrical steel making is adequately considered and discussed. There is a very good chapter on special and alloy steels. Attention may also be directed to the chapter entitled "Pit Work," which is an excellent summary of this important part of melting-shop practice.

In comparing the acid and basic processes, the author states that the acid process is essentially a means of producing the very highest qualities of steel, and where

quality is the main consideration the prices obtained are correspondingly high. It follows, therefore, that more time is allowed to the man working acid charges in order that the material shall reach the necessary standard and successfully pass all the severe and stringent tests required of it. In the basic process conditions are different. The materials used are less than half the price of those used in the acid process. In spite of this it supplies material of sufficiently good quality for a variety of purposes and its cheapness and rapidity of output renders it available in large quantities for general constructional work. The author insists that the most important point of superiority of acid steel is its ductility and resistance to shock and that the reason for this is entirely the nature of the slag. He writes: "The composition of the slag of an acid charge almost prohibits the existence of any dissolved oxide of iron in the steel and this is the whole secret of its superiority. . . . From the commencement of the working of the charge, any free oxide of iron contained in the bath is immediately attacked by the silica of the hearth forming a silicate which makes its way into the slag. When iron ore is fed, any surplus oxide of iron not reduced by the carbon of the charge or taken up by the silicon of the pig, is immediately taken up by the silica of the hearth, and this can always be noticed in the cutting action of a thin slag which is always a slag containing an excess of oxide of iron. In the basic process this is not so, all the available silica being taken up by the lime of the slag, leaving none to combine with any free oxide of iron, so that all the deoxidising has been done by the addition of siliceous materials or other deoxidisers either to the bath or to the ladle, which at the best are never so completely successful as the natural conditions and reactions pertaining to the acid open-hearth."

This difference between acid and basic steel is most marked in bath samples. In the former the skin of a sample is always beautifully bright and glossy, the sample thus being absolutely solid and free from blow-holes and the grain of the steel fine and dense. In the latter the skin of a basic sample of the same analytical composition is dull and lustreless. The sample is pitted with blow-holes and the grain is coarse and open. The author points out the significant fact that it is much more easy to obtain low carbon in the basic (below 0.10 per cent.) than it is in the acid process. It is the exception rather than the rule to obtain carbon below 0.15 per cent. in the latter process. This again points to the absence of free or dissolved oxide of iron in the acid after feeding has ceased, whereas it is always present in the basic even after all feeding has ceased for some time.

Under the heading "Neutral Steel" a process is described whose object is to obtain the good qualities of acid steel in a basic-lined furnace. It consists of first charging a layer of good clean scrap on the furnace bottom and then the whole of the pig iron which is hematite and may constitute about 50 per cent. of the charge. When this is melted the remainder of the scrap is charged into it in small portions at intervals until the charge is complete and the whole melted up. The high silicon content of the hematite pig keeps the bath to a large extent free from oxide of iron during melting, and care is taken to avoid any further additions of oxide as much as possible, more scrap being used if necessary to reduce the carbon content of the bath.

The book is well printed and adequately illustrated. It is to be hoped that it will be carefully studied by those for whom it is intended. Considering what it gives, it cannot be regarded as expensive at 25s. All the same, this price will keep it out of the reach of many into whose hands it should fall. If it were possible to issue a cheaper edition, this would undoubtedly be a great boon to the men engaged in the industry.

THE STYLES OF ENGLISH ARCHITECTURE. Part II. By A. Stratton, F.R.I.B.A.
London: B. T. Batsford, Ltd. Paper, 1s. 6d.; Cloth, 2s. 6d

This is the second of Mr. Stratton's Introductory Handbooks. The first brought us down to the end of the 15th century, and this one takes us to the end of the 18th. The Handbooks are companions to a series of large scale comparative diagrams (10 x 20 inches) intended for students and teachers.

These diagrams are reproduced on a small scale in the Handbooks, and the illustrations leave us no doubt as to their utility and excellence. Each one consists of a plan, an elevation or interior, and details of stone or woodwork. Every stage in the evolution of English architecture is represented.

The short descriptive text is very much to the point. Enough is said about history to account for the main developments before Inigo Jones, from whose time the personality of great architects counts for as much as the more impersonal elements of time and change.

Mr. Stratton really provides the kind of summary that is so welcome to those who have been working laboriously, and have at last begun to suffer from a mental indigestion. Salient facts are a fine aperient; they are perhaps less valuable as a complete food for the ignorant. When students have reached the end of their fat text-book let them turn to Mr. Stratton.

ARCHITECTURE AS A CAREER. By P. A. Robson, F.R.I.B.A. London: B. T. Batsford, Ltd. 5s.

This "manual for aspirants and students of either sex" ought to lie about in the junior common rooms of our universities, so as to fall into the hands of undergraduates at what is a very critical period of their careers. The young man and maiden with humanistic inclinations generally feel despairingly that only in the overcrowded literary world might they solve their problems of subsistence and self-realisation.

Architecture appeals to them, but as a profession it seems only a remotely possible choice. Now there are difficulties here as elsewhere, and competition is keen here, too, but once these difficulties are clearly understood they appear less insuperable than before.

Mr. Robson's plain-spoken little book will quickly show the aspirant how he or she stands; what examinations have to be passed and what studies these examinations involve. Those who can afford the cost of living without earning for the requisite time, will not find the fees asked by the schools and the R.I.B.A. exorbitant.

It is after all possible that we are on the eve of a great modern movement in building, and that exceptional opportunities are awaiting students who will be starting to practice in four or five years.

P.B.

GENERAL NOTE.

BRITISH INSTITUTE OF INDUSTRIAL ART.—The British Institute of Industrial Art will hold its Autumn Exhibition in the North Court of the Victoria and Albert Museum, S.W. 7, from the 9th November to the 18th December (Admission free). The main part of the Exhibition will consist of examples of British Industrial Art for the slender purse, including Furniture, Pottery, Textiles, Metalwork and products of the Building Crafts and the Book and Printing Trades. The Exhibition will also include the Institute's Permanent Collection of recent work by British artists, craftsmen and manufacturers; and a section illustrating certain modern tendencies in European Industrial Art.

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

MONDAY, OCTOBER 21. East India Association, at Caxton Hall, Westminster, S.W. 4.30 p.m. Mr. S. K. Ratcliffe "America and India."

University of London, at Bedford College for Women, Regents Park, N.W. 4.30 p.m. Prof. Geyl, "The Revolt of the Netherlands" (Lecture II). At King's College, Strand, W.C. 5.30 p.m. Dr. Prof. A. Hevesi, "Great Figures of Hungarian Literature." (Lecture IV).

At King's College, Strand, W.C. 5.30 p.m. Rev. G. E. Newson, "The Church and the World. Lecture III. Medieval Catholicism." At University College, Gower Street, W.C. 5 p.m. Dr. R. J. Brocklehurst, "Secretion of the Digestive Juices." (Lecture II).

At University College, Gower Street, W.C. 5.30 p.m. Prof. J. Macmurray, "The Philosophical Approach to Modern Social Problems." (Lecture I). At University College, Gower Street, W.C. 5.30 p.m. Mr. Arthur Stratton, "England in Shakespeare's Day. Lecture I—Houses in Tudor Times."

TUESDAY, OCTOBER 22. Advertising, Institute of Incorporated Practitioners in, at the Royal Society of Arts, Adelphi, W.C. 7.15 p.m.

Arts, Royal Academy of, Burlington House, W. 4.30 p.m. Prof. Arthur Thomson, "Anatomy—The Essential Features of the Face, Head and Neck." Historical Society, at Stroud Green School, Finsbury Park, N. 6.30 p.m. Dr. G. P. Gooch, "The Outlook of Europe."

University of London, at King's College, Strand, W.C. 5 p.m. Dr. J. W. Pickering, "Blood Plasma and Platelets." (Lecture III)

At King's College, Strand, W.C. 5.30 p.m. Rev. P. Dearmer, "Byzantine and Byzantineque Art. Lecture III—Sculpture: Bridging the Dark Ages." At King's College, Strand, W.C. 5.30 p.m. Prof. Sir B. Pares, "Russian History to 1861. Lecture II—Kiev and the Water Road."

King's College (at 40 Torrington Square, W.C.) 5.30 p.m. Dr. Julian Krzyzanski, "The Polish Novel in the 19th Century. Lecture I—Henry Sienkiewicz and his Early Novels."

At St. Thomas's Hospital Medical School, Albert Embankment, S.E. 5 p.m. Dr. A. St. G. Huggett, "The Physiology of the Foetus." (Lecture III).

Zoological Society, Regents Park, N.W. 5.30 p.m. Meeting for Scientific Business.

WEDNESDAY, OCTOBER 23. Arts, Royal Academy of, Burlington House, W. 4.30 p.m. Prof. Arthur Thomson, "Anatomy—The Lower Limb. Its Connection with the Trunk. The Surface Forms dependent on Bone and Muscle in Action and Repose."

Automobile Engineers, Institution of, at the Engineers' Club, Manchester. 7 p.m. Prof. W. Morgan, Presidential Address, "The Member and the Institution."

Public Health, Royal Institute of, 37 Russell Square, W.C. 4 p.m. Mr. J. C. Stobart, "Broadcasting and Health."

United Service Institution, Whitehall, S.W. 3 p.m. Major Walter Elliott, M.P., "Co-ordination of Imperial Defence."

University of London, at King's College, Strand, W.C. 5.30 p.m. Dr. F. A. P. Aveling, "Personalism: A Psychological Approach to Reality. Lecture III—The World of Empirical Experience."

At King's College, Strand, W.C. 5.30 p.m. Mr. A. F. Meyendorff, "The Influence of Capitalism on Communism in Russia." (Lecture I).

At King's College, Strand, W.C. 5.30 p.m. Prof. A. W. Reed, "The Contribution of King's College to the Advancement of Learning during the Century, 1829-1928. Lecture III—Language and Literature."

At the London School of Economics, Houghton Street, W.C. 6 p.m. Lecture III "Office Machinery." At University College, Gower Street, W.C. 4.30 p.m. Mr. J. H. Helweg, "Copenhagen, Past and Present." (Lecture II).

THURSDAY, OCTOBER 24. Aeronautical Society, at the Royal Society of Arts, Adelphi, W.C. 6.30 p.m. Captain N. Macmillan, "The Art of Flying Land and Sea Machines."

Asiatic Society, 24 Grosvenor Street, W. 4.45 p.m. Mr. K. A. C. Creswell, "The Aqsa Mosque and the Church of Justinian."

Electrical Engineers, Institution of, Savoy Place, W.C. 6 p.m. Colonel Sir T. F. Purves, Presidential Address. Fuel, Institute of, at the Institution of Mechanical Engineers, Storey's Gate, S.W. 11 a.m. Sir David Milne-Watson, Presidential Address. Papers on "Pulverised Fuel for Marine-Type Boilers" by Mr. C. J. Jefferson, Admiral W. M. Whyman, Mr. Harold E. Yarrow, and Dr. G. E. K. Blythe.

Imperial Institute Cinema, South Kensington, S.W. 2.15 p.m. Colonel V. A. Haddick, "Ireland's Rough-Hewn Destiny."

Rubber Technologists, Institution of, at the Manchester Cafe Ltd., Exchange Buildings, Manchester. 7 p.m. Mr. F. Walker, "Application of Electricity in the Rubber Industry." Annual General Meeting.

University of London, at Bedford College for Women, Regents Park, N.W. 4.30 p.m. Prof. Ecoles, "Montaigne." (Lecture III).

At Bedford College for Women, Regents Park, N.W. 5.15 p.m. Mr. J. M. Keynes, "The Advisability of Methods other than High Wages as a Means of Improving the Conditions of the Working Class."

At King's College, Strand, W.C. 5 p.m. Dr. J. A. Hewitt, "Metabolism of the Carbohydrates and Fats." (Lecture II).

At King's College, Strand, W.C. 5.30 p.m. Mr. H. W. Stead, "The Minorities Question and the Union of Europe. Lecture II—Minorities Before and After the War."

At University College, Gower Street, W.C. 5.30 p.m. Prof. J. E. Neale, "The Elizabethan Parliament" (Lecture II).

FRIDAY, OCTOBER 25. Chemical Engineers, Institution of, at the Institution of Civil Engineers, Great George Street, S.W. 6.30 p.m. Dr. W. H. Hatfield, "The Fabrication of Acid-Resisting Steel Plant."

Fuel, Institute of, at the Institution of Mechanical Engineers, Storey's Gate, S.W. 10.15 a.m. (1) Mr. J. S. Atkinson, "The Installation and Operation of Gas Producer Plants for Industrial Furnaces." (2) Mr. E. C. Evans, "The Economics of Coke-Oven Gas Utilisation in Industry." (3) Mr. E. H. Lewis, "Heat Insulation." (4) Messrs. A. J. Dale and A. T. Green, "Fuel Control in the Ceramic Industry." (5) Messrs. A. J. Dale and A. T. Green, "Refractories in Application to the Fuel Industries."

Junior Institution of Engineers, 39 Victoria Street, S.W. 7.30 p.m. Mr. Harold Brunt, "Electric Welding as Applied to Bridges and other Structures on the L & N.E. Railway."

Mechanical Engineers, Institution of, Storey's Gate S.W. 7 p.m. Mr. I. C. Dewhurst, "The Requirements of Overseas Locomotive Engineers in respect of Locomotive Design and Details."

North East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle-upon-Tyne, 6.30 p.m. Annual General Meeting.

Physical Society, at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W. 5 p.m. 1. Mr. F. C. Connelly, "Some Additional Lines in the Secondary Spectrum of Hydrogen." 2. Dr. E. G. Richardson and Mr. E. Tyler, "The Transverse Velocity Gradient Near the Mouths of Pipes in which an Alternating or Continuous Flow of Air is Established." 3. Mr. B. K. Johnson, "Resolving-Power Tests on Microscope Objectives Used with Ultra-Violet Radiation."

Public Health, Royal Institute of, 37 Russell Square, W.C. 5 p.m. Prof. Dr. R. A. Peters, "The Ministers of Metabolic Change. Experimental Researches upon the Nature and Distribution of the Water Soluble Vitamins."

University of London, at King's College, Strand, W.C. 5.30 p.m. H.E. The Greek Minister, "Byron and Greece."

At King's College, Strand, W.C. 5.30 p.m. Prince D. S. Minsky, "The Russian Drama. Lecture II—Griboyedov: Shebekin and Realism on the Stage."

At King's College, Strand, W.C. 5.30 p.m. Prof. D. Saurat, "The French Novel. Lecture I—Pierre Hump et le roman du travail."

At King's College for Household and Social Science, 61 Campden Hill Road, W. 5 p.m. Prof. V. H. Mottram, "Human Nutrition." (Lecture II).

At University College, Gower Street, W.C. 5.30 p.m. Mr. C. S. Epton, "The Future of Animal Ecology." (Lecture I).

SATURDAY, OCTOBER 26. L.C.C., Horalman Museum, Forest Hill, S.E. 3.30 p.m. Dr. G. Ainsworth Mitchell, "Faces and Finger Prints."

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4014.

VOL. LXXVII.

FRIDAY, OCTOBER 25th, 1929.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W C (2)

NOTICE.

OPENING OF THE 176TH SESSION.

The Opening Meeting of the 176th Session will be held at 8.30 p.m. on Wednesday, November 6th, when the Inaugural Address will be delivered by MR. LLEWELYN B. ATKINSON, M.I.E.E., Assoc. M.Inst.C.E., Chairman of the Council. The subject will be "Fifty Years of Electrical Science and Industry."

After the delivery of the Address, the Society's silver medals awarded for papers read last session will be presented.

Tea and coffee will be served in the Library at the end of the proceedings

ROYAL SOCIETY OF ARTS.

REPORT ON THE SOCIETY'S EXAMINATIONS, 1929.

THE EXAMINATIONS COMMITTEE.

Last year the entries for all the Examinations held by the Society for the first time reached a total of over 100,000. In view of their growing importance, the Council thought it advisable to reconstruct the Committee which is charged with the conduct of the Examinations. It is a body consisting at present of thirty-seven members, of whom seven are nominated by the Council, two by Central Education Authorities, thirteen by Local Education Authorities, one each by the Association of Education Committees, the Association of Directors and Secretaries for Education and the Association of Technical Institutions, five by Teachers' Associations, six by Commercial and Professional Bodies, and one co-opted Member. The Committee are at liberty to co-opt nine more members, as and when occasion may arise. It is now a powerful body, thoroughly representative of educational and commercial interests, and may be trusted to see that the examinations are kept on practical lines and calculated to meet the real needs of the class of students for whom they are intended.

EVENING COMMERCIAL EXAMINATIONS.

The increase in the number of papers worked at all the Society's Examinations which, as will be seen from the diagram on page 1146, has been steadily and rapidly increasing since 1917, has been maintained this year, the total being 100,696.

The Evening Commercial Examinations were held at three periods, March, May and July. In March the number of entries was 26,318, in May 45,285, and in July 18,570. The entries were divided among the three Stages as follows :—

	March.	May.	July.	Total.
Advanced Stage ..	2,292	7,833	—	10,125
Intermediate Stage	8,027	17,820	6,561	32,408
Elementary Stage ..	15,999	19,632	12,009	47,640

The number of papers worked in the written examinations was 85,907, and in addition 586 candidates presented themselves for the *viva voce* Examinations in Modern Languages.

The subjects of Examination this year were :—

Arithmetic.	Commerce.
English.	Railway Law and Practice
Book-keeping.	Railway Economics.
Shorthand.	Shipping Law and Practice
Typewriting.	Law and Practice of Marine Insurance.
Economic Geography.	Stock Exchange Law and Practice.
Economic and Social History	Advertising and Salesmanship.
Economic Theory.	French.
Précis-writing.	German
Commercial Law	Italian.
Company Law	Spanish
Accounting.	Russian
Banking.	Portuguese
Costing.	Swedish
Foreign Exchange	

Arithmetic.—The total number of entries was 11,623. In Stage III there were 420 candidates, of whom 21 obtained first-class certificates, 241 obtained second-class certificates, and 163 failed. A few very excellent papers were worked, but a large number of those who failed were far below the standard required in this Stage. Some of the worst faults are pointed out in the Examiner's solutions, which are printed in the pamphlet containing the examination questions.

In Stage II there were 2,772 candidates, of whom 473 obtained first-class certificates, 1,007 obtained second-class certificates, and 1,292 failed. The Examiner again comments on the tendency of candidates to give the results only without clearly showing how these are obtained. It is the working as much as the results that the Examiner wishes to see, and the one should be set out as clearly as the other. In many cases the whole subject of percentages in its various applications, had not been mastered.

In Stage I of 8,431 candidates, 1,060 passed with credit, 4,851 passed, and 2,520 failed. The mental arithmetic was generally well done, though weakness was shown in the decimalisation of money. In this Stage again, the Examiner complains that the working too often is not properly shown, and candidates should be impressed with the necessity of bearing this point in mind.

English.—The total number of candidates was 7,274. In Stage III there were 425, of whom 21 obtained first-class certificates, 241 obtained second-class certificates, and 163 failed. While a certain number of candidates wrote excellent answers to the questions on literature, many of these were brief and inadequate. Evidently a large number had not spent sufficient time in studying the prescribed books, and some did not seem to understand what they had read, or were unable to express what they knew. In a good many cases the handwriting was difficult to read—a fault which is bound to tell against a candidate.

In Stage II of 2,056 candidates, 246 obtained first-class certificates, 1,228 obtained second-class certificates, and 582 failed. The essays, for the most part, reached a high standard, and the prescribed books had, as a rule, been read with interest. A good many candidates lost marks by failing to observe the instructions given on the examination papers.

In Stage I, of 4,793 candidates, 94 passed with credit, 2,836 passed, and 1,863 failed.

Book-keeping.—The number of papers worked in this subject reached the very large figure of 24,289, as increase of 427 over the total for 1928. In Stage III there were 3,689 candidates, of whom 398 obtained first-class certificates, 1,540 obtained second-class certificates, and 1,751 failed.

In Stage II of 8,553 candidates, 1,278 obtained first-class certificates, 4,810 obtained second-class certificates, and 2,465 failed. The exercises, as a rule, were well worked, but any item at all out of the way was apt to get candidates into difficulties.

In Stage I there were 12,047 candidates, of whom 963 passed with credit, 7,202 passed, and 3,882 failed. After commenting on a number of the commoner blunders and the reasons for them, the Examiner writes: "it is obvious that there are still some centres where candidates do not receive any instruction in the preparation of a Profit and Loss Account and Balance Sheet."

Shorthand.—The total number of candidates this year was 18,558, an increase of 897 over last year's total, when the number of papers sent in was 17,661.

In Stage III there were 1,628 candidates, of whom 225 passed at 140 words per minute, 622 passed at 120 words per minute, and 781 failed. The Examiner reports that many of the transcripts, as well as shorthand notes, were excellent, and that the spelling in this Stage showed improvement.

In Stage II there were 8,809 candidates, of whom 1,827 passed at 100 words per minute, 3,081 passed at 80 words per minute, and 3,901 failed. The work in this Stage varied a good deal. Many of the transcripts were exceedingly good, but some were very much the reverse.

In Stage I there were 8,121 candidates, of whom 2,675 passed at 60 words per minute, 2,287 passed at 50 words per minute, while 3,159 failed. The percentage of failures is higher than last year, and the Examiner remarks upon the large number of blunders, which are due quite as much to the candidates' disregard

of the sense of the context, as to their inability to decipher their shorthand characters, which were often badly or incorrectly formed. Teachers should make their pupils understand that they must not write nonsense. It is far better to stick to the old adage—"When in doubt, leave it out."

Typewriting.—The total number of entries in this subject shows an increase of 575 as compared with that of 1928, the figures being 10,398 and 9,823. In Stage III there were 1,105 candidates, of whom 339 obtained first-class certificates, 660 obtained second-class certificates, and 106 failed. In Stage II of 3,997 candidates, 1,280 obtained first-class certificates, 1,944 obtained second-class certificates, and 773 failed. In Stage I of 5,296 candidates, 1,279 passed with credit, 3,300 passed, and 717 failed.

In all stages the standard of work submitted was generally satisfactory, with the exception of the time tests and the answers to the questions. In the time tests many candidates were so anxious to attain high speeds that they sacrificed everything to this end. Accuracy is obviously the first essential. In answering the questions a good many candidates must have set down the first words that came into their heads, without the slightest regard to common sense; *e.g.*, one wrote, "Record ribbons are not used for making carbon copies, but are employed in cutting stencils." Another: "The operator should sit on the machine," and a third, "Thirty fingers should be used for striking the character keys and the thumbs for the shift-keys." The mentality of the candidates who can produce answers like these leaves one wondering.

Economic Geography.—The total number of candidates was 1,048. In Stage III there were 62, of whom 6 obtained first-class certificates, 37 obtained second-class certificates, and 19 failed. The good papers were very, very good, but the bad were very, very bad. As a rule, the maps were excellent, although in too many cases the descriptions showed that the candidates could not "read" them.

In Stage II of 204 candidates, 29 obtained first-class certificates, 98 obtained second-class certificates, and 77 failed. Here again, the best papers were admirable, especially those worked in March and May, which the Examiner characterises as the best set of Intermediate papers that he has ever had. Three improvements which were noted last year have not only been continued, but emphasised—the sound use of sketch maps, less irrelevancy, and clear efforts to analyse and explain.

In Stage I of 782 candidates, 20 obtained first-class certificates, 448 obtained second-class certificates, and 314 failed. A large number of the failures was due to very marked weakness in answering the two compulsory questions and to the fact that many candidates had only studied portions of the prescribed areas, revealing almost incredible ignorance of the remaining portions. The Examiner writes: "It is lamentable that any preparation for such an examination should not begin with an honest survey of the whole area. In the absence of such a survey it is obvious why so many candidates have seemed to misunderstand some of the simplest geographical phenomena of our islands."

Economic and Social History.—The total number of candidates was 253. In Stage III there were 23 candidates, of whom 8 obtained first-class certificates, 11 obtained second-class certificates, and 4 failed. Though the numbers were small the papers were good, being full of accurate knowledge and lucidly expressed.

In Stage II of 75 candidates, 11 obtained first-class certificates, 35 obtained second-class certificates, and 29 failed. In the May examination the quality of

much of the work was meritorious, and there was only a single failure. The average standard in the July examination was, however, disappointingly low.

In Stage I of 155 candidates, 25 passed with credit, 109 passed, and 21 failed. On the whole the work submitted was of fair to mediocre quality.

Economic Theory.—There were 567 entries in this subject. In Stage III of 191 candidates, 17 obtained first-class certificates, 116 obtained second-class certificates, and 58 failed. A good proportion of the papers showed a solid, intelligent and satisfactory knowledge of the subject, which was evidently the result of careful and interested study, but many candidates should have entered for Stage II rather than for Stage III.

In Stage II of 376 candidates, 58 obtained first-class certificates, 245 obtained second-class certificates, and 73 failed. A good general level was reached; most of the candidates had grasped the elements of the subject and were able to present them intelligently.

Précis-writing.—A good deal is to be said for this subject as a means of training in judgment, accurate thinking, and clear and concise expression. It does not, however, attract many candidates, the total number of entries this year being 151, which is only a slight increase on last year's figure, 132. In Stage III of 36 candidates 2 obtained first-class certificates, 23 obtained second-class certificates, and 11 failed. The passage set called for much judgment in selecting the really important and rejecting the not important. While the best candidates showed not only discretion in selection of facts and skill in arranging them, the worst did very poor work indeed.

In Stage II of 115 candidates, 17 obtained first-class certificates, 53 obtained second-class certificates, and 45 failed. The work on the whole was up to the usual level, and the best papers were quite good.

Commercial Law.—In Stage III there were 160 candidates, of whom 67 obtained first-class certificates, 84 obtained second-class certificates, and only 9 failed. The papers worked were generally good, in particular, those submitted at the March examination were excellent; they were characterised by accuracy and intelligence, and there were no failures.

In Stage II, of 359 candidates, 199 obtained first-class certificates, 130 obtained second-class certificates, and 30 failed. Here again the Examiner reports that the papers, as a whole, were very satisfactory, most of the candidates showing an intelligent knowledge of the principles of mercantile law and their application.

Company Law.—In Stage III there were 91 candidates, of whom 28 obtained first-class certificates, 41 obtained second-class certificates, and 22 failed. The average standard was fairly high, though in the papers worked in March there was in many cases a lack of knowledge of the principles of Company Law, and even of common sense. The Examiner has, unfortunately, to complain of a good deal of illegible writing. If candidates only realised how much they handicap themselves in this way, surely they would take some care to mend their faults.

In Stage II of 217 candidates, 97 obtained first-class certificates, 94 obtained second-class certificates, and 26 failed. Candidates on the whole, showed a very sound knowledge of the principles of commercial law, though here again so many scripts were marred by bad writing that the Examiner finds it necessary to state: "Many candidates forgot that the Examiner can only read answers that are legibly written."

Accounting.—480 candidates entered for this subject, of whom 28 obtained first-class certificates, 240 obtained second-class certificates, and 212 failed. On the whole the papers worked were creditable, and some were very good. A good many candidates evidently possessed no knowledge of executorial accounts, although this is prescribed in the syllabus.

Banking.—Only 15 candidates presented themselves of whom 2 obtained first-class certificates, 9 obtained second-class certificates, and 4 failed. There were no papers of outstanding merit.

Costing.—There were 93 candidates in this subject, of whom 5 obtained first-class certificates, 46 obtained second-class certificates, and 42 failed. A good many confused cost and selling price, while some included profit as an item of cost, and others allowed the costs of one period to be affected by balances of over- or under-absorbed on-costs of previous periods.

Foreign Exchange.—The total number of entries in this subject (26) continues to be small, though it shows an increase of 9 over that of 1928. In Stage III there were 14 candidates, of whom 9 obtained first-class certificates and 5 obtained second-class certificates. The papers were worked in a most encouraging manner, the proportion of first-classes was very high, and there were no failures.

In Stage II, of 12 candidates, 6 obtained first-class certificates, 5 obtained second-class certificates, and one failed. Here, again, the work submitted was decidedly good.

Commerce.—There has been a distinct increase in the number of entries in this subject, the total this year being 2,872 as compared with 2,492 in 1928. In Stage III there were 331 candidates, of whom 9 obtained first-class certificates, 185 obtained second-class certificates, and 137 failed. The Examiner reports that, speaking generally, great ignorance appears to prevail respecting marketing processes, notwithstanding the exhortations and advice from high quarters to study these questions.

In Stage II of 1,038 candidates, 217 obtained first-class certificates, 542 obtained second-class certificates, and 279 failed. The Examiner draws special attention to the excellence of the papers worked at the July examination, which were so good as to leave the impression that they were a specially selected set. In particular, the answers to question 9 were so thorough and detailed that they appeared to be the result of considerable practical experience in the operations described.

In Stage I of 1,503 candidates, 140 passed with credit, 899 passed, and 464 failed. The answers on the whole pointed to very careful preparation and to an improvement in the general standard of intelligence on the part of the candidates. Unfortunately, a good many scripts were marred by bad spelling and bad handwriting.

Railway Law and Practice.—There were 20 candidates in this subject, of whom 2 obtained first-class certificates, 12 obtained second-class certificates, and 6 failed. The candidates generally showed a satisfactory knowledge of railway law, and there was a distinct improvement in preciseness of expression, a point which in the past has often been a source of great weakness.

Railway Economics.—Of 12 candidates, 3 obtained first-class certificates, 6 obtained second-class certificates, and 3 failed. Most of the candidates had a very

weak grounding in elementary economics, and therefore had no sound basis on which to build their knowledge of this subject.

Shipping Law and Practice.—Only 30 candidates entered for this subject, and of these 5 obtained first-class certificates, 14 obtained second-class certificates, and 11 failed. A few of the candidates were well prepared, but in too many cases the issues raised were only half dealt with.

Law and Practice of Marine Insurance.—Of the 42 candidates in this subject, 11 obtained first-class certificates, 22 obtained second-class certificates, and 9 failed. The Examiner reports a considerable improvement in the standard of work as compared with that of 1928, and there is definite evidence of careful tuition. It is regrettable, however, that some of the papers were marred by bad spelling and bad grammar, which ought not to be possible in Stage III.

Stock Exchange Law and Practice.—There were 35 entries in this subject. In Stage III of 13 candidates, 3 obtained first-class certificates, 8 obtained second-class certificates, and 2 failed. The papers generally were well worked. It seems somewhat curious that the questions which were most poorly answered were those which called for any knowledge of arithmetic, and that apparently none of the candidates had any practical acquaintance with the principles of compound interest.

In Stage II of 22 candidates, 8 obtained first-class certificates, 10 obtained second-class certificates, and 4 failed. The general quality of the papers might have been better, and the Examiner reports that in some of them the spelling was noticeably bad.

Advertising and Salesmanship.—The number of candidates has risen this year to 101, as compared with 70 in 1928, and in view of the growing importance of the subject it may be expected that the total will continue to rise. 18 candidates obtained first-class certificates, 55 obtained second-class certificates, and 28 failed. Probably many would have received higher marks had they read the questions more carefully, and too few of them appeared to have had much practice in putting down their thoughts in a concise and definite manner.

French.—The total number of entries in this subject was 5,563. In Stage III there were 365, of whom 32 obtained first-class certificates, 195 obtained second-class certificates, and 138 failed. While the best candidates gave evidence that they possessed really valuable and accurate knowledge it is disappointing to find that the Examiner reports in many cases a lamentable weakness in grammar. Nobody can possess a satisfactory knowledge of a language until it is built up on a sound grammatical basis. This is surely an obvious truism, and yet there are people calling themselves educationalists who apparently think either that grammar is quite unimportant or that it may be picked up anyhow. Many of the commercial candidates were very unsuccessful in dealing with the commercial passages, which were not difficult and only contained phraseology with which they should have been familiar.

In Stage II of 1,750 candidates, 210 obtained first-class certificates, 645 obtained second-class certificates, and 895 failed. Here again, while some of the papers were quite good, the work in general was marred by a deplorable lack of thoroughness. Verbs had too often been only half learnt, tenses were confused, and expressions wildly guessed at without reference to their context. The number of candidates

who attempted the "Commercial" passages was very small, and their work on the whole was very poor indeed. Far too many of the candidates were quite unprepared to sit for an examination of this standard.

In Stage I there were 3,448 candidates, of whom 508 passed with credit, 2,078 passed, and 862 failed. The Examiner's reports on this Stage offer a striking contrast to those on Stages II and III. The results were most satisfactory. "For many candidates the paper was far too easy, and totals of 90 per cent. were by no means uncommon." The grammar, in particular, was of a high standard, and considerable attention had been given to irregular verbs. It is to be hoped that those who have done so well in Stage I will go on to raise the level of work in Stages II and III.

German.—The total number of entries in this subject was 570, as compared with 471 in 1928. In Stage III of 64 candidates, 22 obtained first-class certificates, 26 obtained second-class certificates, and 16 failed. Although the work did not reach the high standard of excellence which has been maintained for some years past, the results may be regarded as satisfactory; the translations into German and the essays were mostly good and some candidates showed that they possessed a very considerable acquaintance with German literature and history.

In Stage II of 176 candidates, 50 obtained first-class certificates, 67 obtained second-class certificates, and 59 failed. In the March examination the standard of accomplishment was higher than it has been for some time. The renderings into English were excellent and the essays were satisfactory. The papers worked in May and July, however, were not so good. Many candidates possessing an adequate vocabulary showed an almost complete disregard of grammar, and the translations into German showed a deplorable weakness in syntax.

In Stage I of 330 candidates, 30 passed with credit, 156 passed, and 144 failed. The general level of the work was fairly satisfactory; the translations into German were somewhat better than usual, but the free compositions were often rambling and ungrammatical.

Italian.—There were altogether 114 candidates in this subject, as compared with 89 in 1928. In Stage III of 17 candidates, 8 obtained first-class certificates, 5 obtained second-class certificates, and 4 failed. The work generally was satisfactory and showed careful preparation on the part of the candidates.

In Stage II of 43 candidates, 9 obtained first-class certificates, 28 obtained second-class certificates, and 6 failed. The papers generally reached a fair standard, although a number of candidates revealed a very imperfect knowledge of Italian grammar.

In Stage I of 54 candidates, 4 passed with credit, 38 passed, and 12 failed. In this Stage the candidates' knowledge of Italian grammar was very defective.

Spanish.—The total number of entries was 908. In Stage III there were 104 candidates, of whom 10 obtained first-class certificates, 76 obtained second-class certificates, and 18 failed. The work maintained about the usual standard. In translation, composition and essay the answers were generally good, most of the candidates possessing a considerable vocabulary and power of expressing themselves correctly, if not always quite idiomatically.

In Stage II of 329 candidates, 22 obtained first-class certificates, 232 obtained second-class certificates, and 75 failed. The work, as a whole, was poor, the grammar was decidedly weak, and many of the candidates were not up to the standard required at this Stage.

In Stage I of 475 candidates, 28 passed with credit, 366 passed and 81 failed. The work compares favourably with that submitted last year; the translations were well rendered, on the whole, and after reading the strictures of the Examiners in other languages, it is satisfactory to learn that the grammar questions were fairly well answered, though there is still room for improvement in this direction.

Russian.—There were 21 entries in all for this subject. In Stage III of 8 candidates, 4 obtained first-class certificates, one obtained a second-class certificate and 3 failed. The work submitted was very encouraging. The best candidates possessed wide vocabularies, and in one case the translation into Russian was almost faultless.

In Stage II of 5 candidates, two obtained first-class certificates, 2 obtained second-class certificates, and one failed. The general standard was good and for the most part the grammatical questions were answered satisfactorily.

In Stage I of 8 candidates, one passed with credit, 4 passed, and 3 failed. There was a noticeable improvement in grammar, but translation into Russian was still very weak.

Portuguese.—Ten candidates entered for this subject. In Stage III there were 5, of whom 3 obtained first-class certificates and 2 obtained second-class certificates. In Stage II there were again 5 candidates, of whom one obtained a first-class certificate, and 4 obtained second-class certificates. In neither Stage was there any failure. No examination was held in Stage I.

Swedish.—This examination was only held in Stage II. There were 7 candidates, of whom one obtained a first-class certificate, 4 obtained second-class certificates, and 2 failed.

ORAL EXAMINATIONS

The results of the Oral Test, which is now compulsory for all candidates in the Advanced Stage of French, German, Spanish, and Italian, were again well up to the average, the figures being much the same as last year. An important part of the Oral Test is the taking down of a passage dictated in the foreign language by the Examiner, and in the past this has been a source of great weakness with many candidates. It is gratifying to be able to state that the examiners now report a very great improvement in this branch of the examination.

ORAL EXAMINATIONS HELD DURING 1929.

Subject.	No. of Examina- tion Centres.	No. of Exami- ners.	No. of Candi- dates examined.	Passed with Dis- tinction	Passed.	Failed
French ..	43	32	402	88	243	71
German ..	13	12	67	21	38	8
Spanish ..	15	13	102	32	56	14
Italian ..	4	3	15	8	5	2
	75	60	586	149	342	95

GROUP CERTIFICATES IN COMMERCIAL SUBJECTS.

The increase, noted in last year's report in the number of candidates entered from advanced classes in Elementary Schools and Central Day Schools has been well maintained. Most of these candidates take a number of subjects qualifying for the Group Certificate in Elementary Commercial Subjects. To gain this special certificate candidates must pass in Arithmetic, English and two other subjects within three consecutive years, but it is satisfactory to find that many pupils from Day Schools have no difficulty in passing in the necessary subjects in one year. In view of this it is hoped that pupils from these schools will enter in future for the more comprehensive Junior School Commercial Certificate Examination which is held in March and July.

The qualification for Group Certificates in the other two stages is as follows :—

Advanced Stage.—Candidates must pass in the following four subjects in the Advanced Stage in three consecutive years : Book-keeping, Commerce, Economic Theory, and any one of the remaining subjects (other than Shorthand, Typewriting, and Précis-Writing), in which an Examination in the Advanced Stage is held.

Intermediate Stage.—Candidates must pass in the following four subjects, either in the Advanced or Intermediate Stage, in three consecutive years : Arithmetic, Book-keeping, Commerce, and any one of the other subjects in which an Examination in the Intermediate Stage is held. (For the purpose of this Certificate, Shorthand and Typewriting are considered as one subject).

The thanks of the Council are once more accorded to the Court of the Cloth-workers' Company, who have generously renewed their grant of £40 towards providing medals in all the subjects of examination where the work of candidates attains a sufficiently high standard. There is no doubt that there is very keen competition for these medals, and that they have done much to maintain or raise the level of excellence in the papers worked.

SCHOOL AND JUNIOR SCHOOL COMMERCIAL CERTIFICATE EXAMINATIONS.

A new series of Examinations was instituted in 1927, specially designed for candidates from Day Schools. Two examinations were held this year in March and July.

The subjects of examination are :—

COMPULSORY SUBJECTS : Arithmetic, Book-keeping, Economic Geography, English, History.

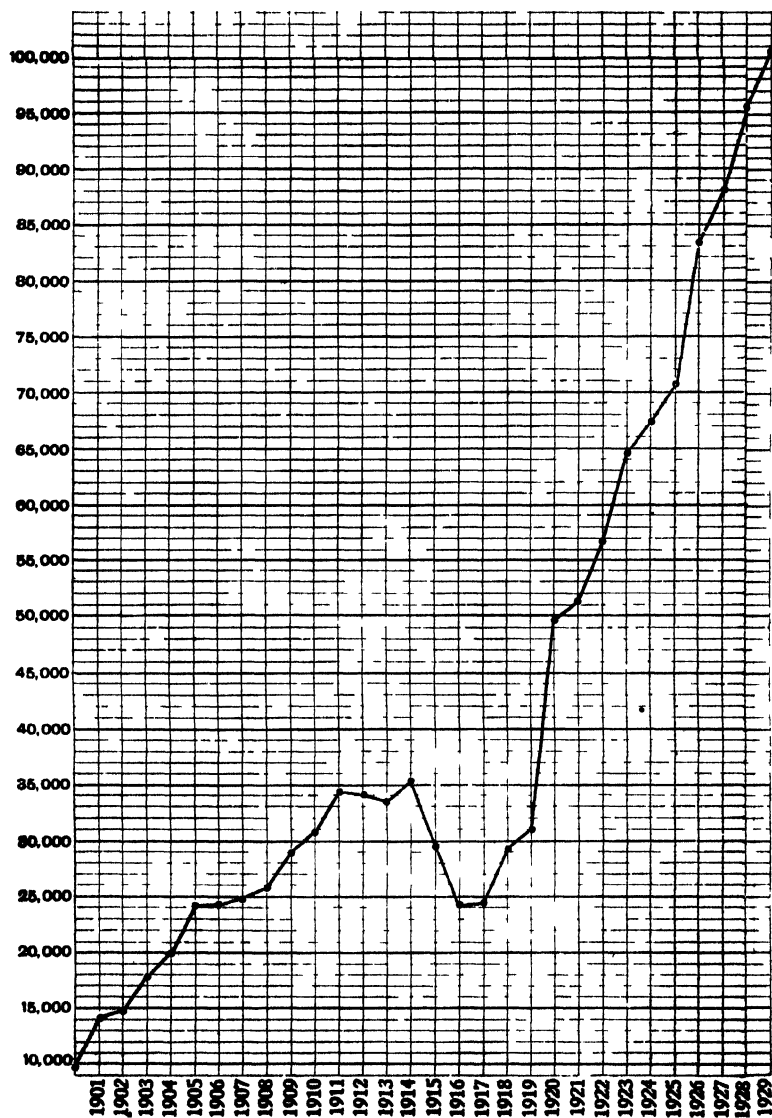
ELECTIVE SUBJECTS : French, German, Spanish, Italian (not more than two foreign languages may be taken), Commerce, Shorthand, Typewriting (School Commercial Certificate only), Mathematics, and Natural Science (Physics, Chemistry, and Botany). Candidates must take not less than two and not more than four of these subjects.

The total number of candidates was 875. Of these 148 entered for the School Commercial Certificate. Nineteen obtained first-class full certificates, and 70 obtained second-class full certificates. For the Junior School Commercial Certificate there were 727 candidates ; 103 obtained first-class full certificates, and 286 obtained second-class full certificates. Candidates who failed to obtain full certificates received certificates for the subjects in which they passed.

SUBJECTS.	STAGE III—ADVANCED				STAGE II—INTERMEDIATE				STAGE I—ELEMENTARY				Total number of Papers worked in all Stages.	
	Papers worked	1st-class Certificates	2nd-class Certificates	Not Passed	Papers worked	1st-class Certificates	2nd-class Certificates	Not Passed	Papers worked	Passed with credit	Passed	Not Passed	1929	1928
Arithmetic ..	420	50	137	233	2,772	473	1,007	1,292	8,431	1,060	4,851	2,650	11,023	11,412
English ..	425	21	241	163	2,056	246	1,228	562	4,793	94	2,836	1,863	7,274	6,882
Book-keeping ..	3,689	398	1,540	1,751	8,553	1,278	4,810	2,465	12,047	963	7,202	3,882	24,289	23,882
Economic Geography ..	82	6	37	19	204	29	98	77	782	20	448	314	1,048	1,201
Shorthand ..	1,628	225	622	781	8,809	1,827	3,081	3,901	8,121	2,675	2,287	3,159	18,558	17,661
Typewriting ..	1,105	339	660	106	3,997	1,280	1,944	773	5,296	1,279	3,300	717	10,398	9,923
Economic and Social History ..	23	8	11	4	75	11	35	29	155	25	109	21	253	268
Economic Theory ..	191	17	116	58	376	58	245	73	—	—	—	—	567	500
Pre-writing ..	38	2	23	11	115	17	53	45	—	—	—	—	151	132
Commercial Law ..	160	67	84	9	359	199	130	30	—	—	—	—	519	530
Company Law ..	91	28	41	22	217	97	94	26	—	—	—	—	308	372
Accounting ..	480	28	240	212	—	—	—	—	—	—	—	—	480	542
Banking ..	15	2	9	4	—	—	—	—	—	—	—	—	15	17
Costing ..	93	5	46	42	—	—	—	—	—	—	—	—	93	99
Foreign Exchange ..	14	9	5	—	12	6	5	1	—	—	—	—	26	17
Commerces ..	331	9	185	137	1,038	217	542	279	1,503	140	899	464	2,872	2,492
Railway Law and Practice ..	20	2	12	6	—	—	—	—	—	—	—	—	20	33
Railway Economics ..	12	3	6	3	—	—	—	—	—	—	—	—	12	11
Shipping Law and Practice ..	30	5	14	11	—	—	—	—	—	—	—	—	30	47
Stock Exchange Law & Practice ..	13	3	8	2	22	8	10	4	—	—	—	—	35	34
Law and Practice of Marine Insurance ..	42	11	22	9	—	—	—	—	—	—	—	—	42	49
Advertising and Salesmanship ..	101	18	55	28	—	—	—	—	—	—	—	—	101	70
French ..	365	32	195	138	1,750	210	645	895	3,448	508	2,078	862	6,563	5,726
German ..	64	22	26	16	176	50	67	59	330	30	156	144	570	471
Italian ..	17	8	5	4	43	9	28	6	54	4	38	12	114	89
Spanish ..	104	10	76	18	329	22	232	75	475	28	366	81	908	935
Russian ..	8	1	1	3	5	2	2	1	8	1	4	3	21	18
Portuguese ..	5	3	2	—	—	—	—	—	—	—	—	—	10	16
Swedish ..	—	—	—	—	7	1	4	2	—	—	—	—	7	8
Totals, 1929 ..	9,544	1,335	4,419	3,790	30,920	6,041	14,264	10,615	45,443	6,827	24,574	14,042	83,907	—
" 1928 ..	9,763	1,190	4,801	3,772	30,075	6,425	14,664	8,986	43,479	7,663	22,602	13,214	—	83,317

In addition to the figures given above, 7,681 papers in the Elementary Stage were worked in May at the Group Course Examination for London County Council Junior Commercial and Technical Institutes, and 7,108 papers were worked at the Junior School and School Commercial Certificate Examinations held in March and July. The stated total of papers worked in 1928 is therefore 176,408.

DIAGRAM SHEWING NUMBERS OF PAPERS WORKED IN THE ROYAL
SOCIETY OF ARTS EXAMINATIONS, 1900—1929.



In 1927 (the first year of this examination), the number of candidates was 312. In 1928 this number increased to 516, and in 1929 to 875.

EXAMINATIONS FOR LONDON COUNTY COUNCIL JUNIOR COMMERCIAL AND JUNIOR TECHNICAL INSTITUTES.

At the request of the Education Committee of the London County Council, the Society undertook again to hold course examinations for (a) students in L.C.C. Junior Commercial Evening Institutes, and (b) students in L.C.C. Junior Technical Evening Institutes.

The total number of entries from both classes of Schools was 2,491. There were 1,627 candidates from the Junior Commercial Institutes, of whom 946 obtained group certificates; and 864 from the Junior Technical Institutes, of whom 513 obtained group certificates.

NOTES ON BOOKS



THE BUILDERS OF AMERICA By E. Huntington and L. F. Whitney London Chapman & Hall, Ltd. 16s. net.

Vagueness and uncertainty are incidental to a study of title page, preface and introduction, indications as to the real scope and purpose of this rather ponderous volume of xvi + 368 pages being somewhat obscure and doubtful until Chapter I of the text is reached.

First readings in the text will make it clear that the builders of whom the authors discourse are not precisely like such men of days gone by as Washington, Longfellow, or Franklin. The builders of the book under notice are in the main to be men of the future, characterised by "fine temperament, fine intelligence, and fine health," p. 1. On p. 23 this sentiment is emphasised, and it is made quite indubitable that the leading function of the builders is to solve problems arising out of the population question. This aspect remains definite to the end of the book, although occasionally obscured by a superfluity of words.

The primary standpoint of the authors is quite definitely contrary to that of certain persons who, in 1877, were prosecuted for publishing a pamphlet by Dr Knowlton which our law-courts held to be objectionable. The primary aspect in the Knowlton pamphlet is that well-intentioned persons should strive towards a lower rate of increase for themselves, but an eminent biologist having convinced one of the prosecuted persons that if the well-intentioned and intellectual classes reduce their output of children, something like racial suicide must follow, this propagandism by the Knowltonist party ceased or waned for a time.

It is now easy to understand the psychology of the authors in relation to their main proposition, that racial improvement depends on the good and the worthy having larger families than the average. Reading from p. 27 to p. 30, we find an estimate, founded on actuarial data available in the United States, that the output of children required to keep the population stationary is 3.1, on the average, from each fruitful marriage; but the authors strive towards a material increase of this output from the high-minded and intellectual persons whom they classify as builders. Apparently nothing short of an average increase of one per family from the intellectual builders will satisfy them, this making the average family of the intellectuals 4.1; but it is contended that to make the future of America safe, this output must be raised to about 4.5.

One aspect in the plan for arriving at the better status is touched upon where we read of the old Rabbinical teaching that a man should sell all that he has in order to obtain the daughter of a learned man as a wife (p. 73), and on p. 284 the authors appear to disclaim all wish for governmental control of marriage; but further on such control seems to be quite positively stated. Thus, towards the end of p. 284, we read:—"When eugenic ideas at last prevail among the great majority of sensible people, legislation will of course follow suit." On p. 285 this anticipated legislation is shown to us in a form which seems impossible in any civilised community or in any state upholding the Christian or Jewish religions. All those who are condemned as degenerate on any one of seven more or less specific counts, one of which counts is the rather indefinite "crime," and another the still less definite "- and the like!" are to be altered or unfunctioned so as to *eliminate child bearing*. To those who have studied the history of times long past such proposals bring visions in which the woman who has been altered, and so protected against usual consequences, becomes a vivid and ever-active agent in spreading degenerations far transcending anything which has been attributed to the most lurid of modern nocturnal revels, as in some of the South European or Levantine night clubs, cabaret shows, or the like. The rites attributed to the worship of Astarté, the Phœnician Venus, called "Ashtoreth, the goddess of the Zidonians," in I Kings, c. xi, v. 5, may be mentioned as an exemplar.

The good intentions and sincerity of the authors are manifest, but to carry into effect their first-mentioned proposal may prove difficult and impracticable, as we know that all through organic nature the higher forms tend towards lower fecundity. The second proposal does not now loom before us very definitely or threateningly, so we can postpone a study of the various contentions that may be brought against it. Meanwhile the mind may not inaptly turn to a quotation which W. R. Grove, eminent as physicist, Queen's Council and Judge, presents to us on p. 78 of the 1855 edition of his "Correlation of the Physical Forces."

"Nature is made better by no mean,

But Nature makes that mean; so o'er that art,
Which we say adds to Nature, is an art
That Nature makes."

SPEECH AND HEARING. By Harvey Fletcher. (Introduction by H. D. Arnold.)
London: Macmillan and Co., Ltd. 21s. net.

Dr. Fletcher in his Volume of 332 + xvi pages, with considerably over 200 definitely important and pertinent figures, gives a carefully ordered and lucid account of the remarkably rapid progress in our knowledge of Speech which characterises the century 1829-1929. We may regard the record and study by Dr. Fletcher as historically sequent to and fitting in with Sir David Brewster's account of Speech and its artificial reproduction; the scope ranging from conjectures as to the statue of Memnon to the year 1832.

Brewster's classic account of the early history of speech reproduction is contained in his "Letters on Natural Magic" (Physical Science), "addressed to Sir Walter Scott," and published by Murray in 1832. Much emphasis is given by Brewster to the means employed by Kratzenstein in constructing his "Talking Automaton" which, although not perfect was good enough to win the prize offered in the year 1779 by the Imperial Academy of Sciences at St. Petersburg, and Brewster's Fig. 47 (p. 207) shows us the devices by which Kratzenstein produced the five primary vowel sounds. In reference to this system mainly, Brewster on his page 211, makes a prediction as follows: ". . . we have no doubt that

before another century is completed a talking and a singing machine will be numbered among the conquests of science."

Dr. Fletcher's work, now before us for review, is, we consider, the first which indicates in clear theory and detail the realisation of Brewster's prediction published in 1832, and for this reason, even if no other, it should be a volume to add lustre to the reputation of the publishers. The author, Dr. Fletcher, on his page 8 and by his fig. 2 gives us thirteen aspects of mouth, lips and tongue, showing how pure-vowel sounds and diphthongs are produced; while fig. 3, on page 11, shows a scheme for originating artificially the fundamentals of speech.

We need not enlarge on this aspect—the origination of speech or song; but the available possibilities run through the book ready to be grasped by the inventor, as, for example, one who wishes to add words, perhaps in numerous languages, for synchronised use with an existing cinematograph film. As may be expected the bulk of the book deals with derived sounds which come by various means from actual sounds, the telephone and the Edison groove, as incised or pressed on a revolving cylinder or disc, figuring largely.

Noise, as distinguished from speech or song, is considered from many aspects. An almost ever-present source of noisy confusion is the distortion which reverberant rooms (whether at the source or destination), and the persistence or "over-hang" which reverberant objects produce. On pp. 292-295 we are given five graphs which, with the text, do much towards giving an insight into the almost ever-present reverberation impurities in speech-sound as it reaches the ear; but we must go back to p. 99 and very carefully study the chapter on noise, as distinguished from "pure tone," music, or speech, and devices are described by which approximate quantitative estimates may be made of noise. To give some idea as to one of the methods, reference may be made to p. 105, where we read how an artificial noise is balanced against the interfering noise.

Taking the work in all its aspects, it must be regarded as an essential addition to the library of every physicist, telephone-engineer, musician or orator who wishes to keep abreast with the rapid industrial progress of our times.

GENERAL NOTE.

ARTIST-CRAFTSMAN EXHIBITION, CENTRAL HALL, WESTMINSTER.—This annual exhibition, which is held this year at the Central Hall, Westminster from Saturday, October 26th, to Wednesday, November 6th, inclusive (from 11 a.m. to 7 p.m.), consists of a representative display by a score of trained modern craftsmen practising the traditional crafts, including pottery, hand-made jewelry, iron and leather work, printing, illumination, weaving and other crafts. The exhibit by rural smiths and saddlers is a step towards the development of these crafts in other directions than in those merely auxiliary to the motor garage. The exhibition will include demonstrations of pottery making, etc.

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

MONDAY, OCTOBER 28. Electrical Engineers, Institution of, Savoy Place, W.C. 7 p.m. Discussion on "Systematic Research by Industrial Undertakings." Opened by Colonel Sir T. F. Purves.
At Armstrong College, Newcastle-on-Tyne. 7 p.m.
Mr. B. A. Robinson, Chairman's Address.
University of London, at Bedford College for Women,

Regent's Park, N.W. 4.30 p.m. Prof. Geyl, "The Revolt of the Netherlands." (Lecture III).
At King's College, Strand, W.C. 5.30 p.m. Rev. G. E. Newson, "The Church and the World." Lecture IV.—The Reformation.
At University College, Gower Street, W.C. 2 p.m. Rev. Canon Claude Jenkins, "Religion and the Church in Shakespeare's Day."
At University College, Gower Street, W.C. 5 p.m. Dr. R. J. Brocklehurst, "Secretion of the Digestive Juices." (Lecture III).

At University College, Gower Street, W.C. 5.30 p.m. Prof. J. Macmurray, "The Philosophical Approach to Modern Social Problems." (Lecture II).

TUESDAY, OCTOBER 29. Arts, Royal Academy of, Burlington House, W. 4.30 p.m. Prof. Arthur Thomson, "Anatomy—The Lower Limb. Its Connection with the Trunk. The Surface Forms dependent on Bone and Muscle in Action and Repose." (Lecture II).

Chadwick Public Lecture, at the British Medical Association, Tavistock Square, W.C. 5.15 p.m. Prof. J. Boeke, "The Histological Basis of Health. Lecture I—The Tissues in Youth and Age."

Electrical Engineers, Institution of, at the Hotel Metropole, Leeds. 7 p.m. Mr. T. Koles, Chairman's Address.

At the College of Science and Technology, Leicester 6.45 p.m. The Hon. Sir Charles A. Parsons and Mr. J. Rosen, "Direct Generation of Alternating Current at High Voltages."

Transport, Institute of, at the Institution of Electrical Engineers, Savoy Place, W.C. 5.45 p.m. Informal Meeting. Opener: Mr. D. Ross-Johnson.

University of London, at King's College, Strand, W.C. 5 p.m. Dr. J. W. Pickering, "Blood Plasma and Platelets." (Lecture IV).

King's College (at 40 Torrington Square, W.C.) 5.30 p.m. Dr. J. Kryzhanowski, "The Polish Novel in the 19th Century. Lecture II—Henry Sienkiewicz and his Later Achievements."

At King's College, Strand, W.C. 5.30 p.m. Prof. J. S. Mackenzie, "The Conception of a Cosmos."

At King's College, Strand, W.C. 5.30 p.m. Prof. Sir B. Pares, "Russian History to 1861. Lecture III—Break-up at Kiev: Migrations: The Tartars."

At the London School of Economics, Houghton Street, Aldwych, W.C. 5 p.m. Prof. Dr. M. J. Bonn, "Some Relations between Economics and Politics in present-day Germany." (Lecture I).

At St. Thomas's Hospital Medical School, Albert Embankment, S.E. 5 p.m. Dr. A. St. G. Huggett, "The Physiology of the Fetus." (Lecture IV).

WEDNESDAY, OCTOBER 30. Eugenics Society, at Burlington House, W. 5.15 p.m. Prof. S. J. Holmes "The Biological Trend of the Negro."

Literature, Royal Society of, 2 Bloomsbury Square, W.C. 5 p.m. Ordinary Meeting.

Mining Engineers, Institution of, Burlington House, W. Annual General Meeting. (1) Mr. H. Eustace Mitton, Presidential Address: (2) Mr. Robert Clive, "Abstract of Report on the Underground Conveying and Loading of Coal by Mechanical Means."

Public Health, Royal Institute of, 37 Russell Square, W.C. 4 p.m. Dr. A. F. Hurst, "The Asthma Problem."

United Service Institution, Whitehall, S.W. 3 p.m. Captain H. J. Feakes, R.A.N., "Australia's Part in Naval Defence."

University of London, at King's College, Strand, W.C. 5.30 p.m. Prof. E. V. Appleton, "The Contribution of King's College to the Advancement of Learning during the Century 1829-1928. Lecture IV—The Physical Sciences."

At King's College, Strand, W.C. 5.30 p.m. Dr. F. A. P. Aveling, "Personalism: A Psychological Approach to Reality. Lecture IV—The World of Ideal Experience."

At King's College, Strand, W.C. 5.30 p.m. Mr. A. F. Meyendorff, "The Influence of Capitalism on Communism in Russia." (Lecture II).

At the London School of Economics, Houghton Street, Aldwych, W.C. 5 p.m. Prof. Dr. M. J. Bonn, "Some Relations between Economics and Politics in present-day Germany." (Lecture II).

At the London School of Economics, Houghton Street, W.C. 6 p.m. Lecture IV on "Office Machinery."

At the School of Oriental Studies, Flinbury Circus, E.C. 5.15 p.m. Dr. Alice Werner, "Kingdom of Congo."

At University College, Gower Street, W.C. 5.30 p.m. Major C. Davenport, "Beautiful Books." At University College, Gower Street, W.C. 5.30 p.m. Mr. J. H. Helweg, "Copenhagen, Past and Present." (Lecture III).

THURSDAY, OCTOBER 31. Arts, Royal Academy of, Burlington House, W. 4.30 p.m. Prof. Arthur Thomson, "Anatomy—The Lower Limb. Its Connection with the Trunk. The Surface Forms dependent on Bone and Muscle in Action and Repose." (Lecture II).

Automobile Engineers, Institution of, at the Queen's Hotel, Birmingham. 7 p.m. Prof. W. Morgan, Presidential Address, "The Member and the Institution."

University of London, at Bedford College for Women, Regent's Park, N.W. 4.30 p.m. Prof. E. C. Montaigne, (in French). Lecture IV.

At King's College, Strand, W.C. 5 p.m. Dr. J. A. Hewitt, "Metabolism of the Carbohydrates and Fats." (Lecture III).

At King's College, Strand, W.C. 5.30 p.m. Mr. H. W. Stead, "The Minorities Question and the Union of Europe. Lecture III—The Value of Racial Individuality."

At the London School of Economics, Houghton Street, Aldwych, W.C. 5 p.m. Prof. Dr. M. J. Bonn, "Some Relations between Economics and Politics in present-day Germany." (Lecture II).

At University College, Gower Street, W.C. 5.30 p.m. Prof. J. F. Neale, "The Elizabethan Parliament" (Lecture III).

FRIDAY, NOVEMBER 1. Anthropological Institute, at the Portland Hall, Great Portland Street, W. 5.30 p.m. Prof. G. Elliot Smith, F.R.S., "The Evolution of Man."

Electrical Engineers, Institution of, Savoy Place, W.C. 7 p.m. Mr. E. W. Hill (Chairman of the Meter and Instrument Section). Inaugural Address.

Junior Institution of Engineers, 39 Victoria Street, S.W. 7.30 p.m. Informal Meeting. Technical Film, "The Age of Speed."

Mechanical Engineers, Institution of, Storey's Gate, S.W. 6 p.m. Prof. H. L. Callendar, "Critical Relations between Water and Steam." (Thomas Hawksley Lecture).

North East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle-upon-Tyne. 6 p.m. Mr. W. S. Burn, "The Development and Performance of the Richardson-Westgarth Oil Engine."

Philosophical Society, at University College, Gower Street, W.C. 8 p.m. Prof. E. Wessley, "Words and Names, Public Health, Royal Institute of, 37 Russell Square, W.C. 5 p.m. Prof. Dr. R. A. Peters, "Tissue Anarchy as illustrated by the present position of our knowledge upon the changes produced in the higher animal by lack of Vitamin B." (Harben Lecture).

University of London, at King's College, Strand, W.C. 5.30 p.m. H. E. Dr. J. Gennadius, "Sources for the History of the Greek War of Independence."

At King's College, Strand, W.C. 5.30 p.m. Monsieur Pierre Hamp, "The French Novel. Lecture II—Le travail dans la littérature française."

At King's College, Strand, W.C. 5.30 p.m. Prince D. S. Minsky, "The Russian Drama. Lecture III—Gogol and Sukhovo-Kobylin."

At King's College for Household and Social Science, 61 Camden Hill Road, W. 5 p.m. Prof. V. H. Mottram, "Human Nutrition." (Lecture III).

At University College, Gower Street, W.C. 5.30 p.m. Mr. C. S. Epton, "The Future of Animal Ecology." (Lecture II).

At University College, Gower Street, W.C. 5.30 p.m. Sir Richard Lodge, "English Parties and Foreign Policy in the Eighteenth Century." (Lecture I).

SATURDAY, NOVEMBER 2. L.C.C. The Horniman Museum, Forest Hill, S.E. 3.30 p.m. Miss M. A. Murray "Ancient Egyptian Sculpture in Relief."

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4015.

VOL. LXXVII.

FRIDAY, NOVEMBER 1st, 1929.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.(2.)

NOTICES.

OPENING OF THE 176TH SESSION.

The Opening Meeting of the 176th Session will be held at 8.30 p.m. on Wednesday, November 6th, when the Inaugural Address will be delivered by MR. LLEWELYN B. ATKINSON, M.I.E.E., Assoc. M.Inst.C.E., Chairman of the Council. The subject will be " Fifty Years of Electrical Science and Industry."

After the delivery of the Address, the Society's silver medals awarded for papers read last session will be presented.

Tea and coffee will be served in the Library at the end of the proceedings.

COUNCIL.

A Meeting of the Council was held on Monday, October 14th. Present :— Mr. Llewelyn B. Atkinson, M.I.E.E., in the Chair ; Sir Charles H. Armstrong ; Sir William Henry Davison, K.B.E., D.L., M.P. ; Sir Edward Gait, K.C.S.I., C.I.E. ; Sir Robert Abbott Hadfield, Bt., D.Sc., F.R.S. ; Col. Sir Arthur Holbrook, K.B.E. ; Mr. P. Morley Horder, F.S.A. ; Sir Herbert Jackson, K.B.E., F.R.S. ; Major Sir Humphrey Leggett, R.E., D.S.O. ; Sir Reginald A. Mant, K.C.I.E., C.S.I. ; Mr. J. A. Milne, C.B.E. ; Mr. James Swinburne, F.R.S. ; Mr. Alan A. Campbell Swinton, F.R.S. ; Sir George Sutton, Bt., and Mr. Carmichael Thomas, with Mr. G. K. Menzies, M.A., Secretary, and Mr. W. Perry, B.A., Assistant Secretary.

Mr. Alfred C. Bossom, F.R.I.B.A., was elected a Member of the Council in place of Mr. Alfred Carpmael, resigned.

The following candidates were duly elected Fellows of the Society :—

Banks, Percy H. B., A.R.I.B.A., Brighton.

Bittinger, Fritz John, Boston, Mass., U.S.A.

Clark, Professor George L., Ph.D., Urbana, Illinois, U.S.A.

Fisher, Joseph Alfred, Shortlands, Kent

Gardiner, J. R., M.I.E.E., London.
 Garland, Claude Mallory, Chicago, Illinois, U.S.A.
 Grady, Ernest, Sheffield.
 Hall, Frederick J. S., Rickmansworth, Herts.
 Harrison, Maynard Colchester, Newport, Mon.
 Horsfall, Herbert, Perth, Western Australia.
 Lind, Walter P., Surbiton, Surrey.
 McInnes, Alexander Neil, Littleover, Derby.
 Mistry, Cursedji D., Bombay, India.
 Needham, Albert, London.
 Rai, Rai Bahadur Jagdish Narain, Gorakhpore, India.
 Sett, Adi K., Bombay, India
 Tier, Professor G., Prague, Czechoslovakia.
 Walker, Frederic Joseph, Sydney, Australia.
 Way, Allan Jay, Sydney, Australia.
 Wilson, Oscar, Singapore, Straits Settlements.

The thanks of the Council were accorded to Sir Alfred Yarow, Bt., F.R.S., for a donation of a hundred guineas towards the reduction of the debt on the Building Fund, which now amounts to about £4,000.

A report in connection with the reconditioning of West Wycombe was considered.

The arrangements for the meetings during the forthcoming session were considered.

It was reported that the various Sectional Committees of the Annual Competition of Industrial Designs were engaged in drawing up the programme for 1930.

A quantity of financial and formal business was transacted.

REPORT ON THE COMPETITION OF INDUSTRIAL DESIGNS, 1929.*

INTRODUCTION.

The Annual Competition of Industrial Designs was held for the sixth time this year. There was again an increase in the numbers over those of 1928, viz., 1,219 candidates and 3,669 designs, as compared with 1,024 candidates and 3,126 designs.

There are probably several reasons for this growth. In the first place the amount of the prizes offered was over £2,000, as against £1,600 in 1928. In the second place the Competition is coming to be more and more widely recognised as providing the best opportunities for young designers to show what they can do and of bringing them into touch with manufacturers and others

* Owing to considerations of space it has been found necessary to omit from the Report the lists of Central and Sectional Committees, of panels of judges, and of donors of prizes and scholarships. These however will be included in the separately printed Report which will be issued shortly.

likely to be able to make use of their services. Manufacturers also are appreciating more and more the assistance which the Competition gives them in discovering young talent, and a number of important firms have already signified their desire to offer prizes for the Competition of 1930. Appreciative leading articles drawing attention to the value of the movement have appeared in *The Times*, the *Manchester Guardian* and many other important newspapers, and no doubt, this publicity has done a very great deal to popularise the Competition.

There are always to be found a number of critics who complain that much of the work submitted shows lack of technical knowledge and is, therefore, unsuitable for immediate commercial reproduction. While it is, no doubt, desirable that more attention should be paid in the Schools of Art to the technical side of design, it should not be forgotten that most of the candidates in this competition are either still in the student stage or are only just out of it, and it is hardly fair to expect them to produce work which can be compared for technical excellence with the work of mature designers. While, therefore, they hope to effect a gradual improvement in this direction, the main object of the promoters of the scheme is to encourage those who possess ideas and originality, in the belief that a young artist of bright and fresh talent will soon acquire the necessary technical knowledge when he has opportunities of doing so. As evidence of this a designer who was given an appointment on the designing staff of a very large textile firm as a result of winning a Travelling Scholarship offered by them in 1927 has this year produced a "best seller," whilst another prize-winner of that year, who also received an appointment on winning a prize offered by another important textile firm, is also very highly spoken of by her employers.

In connexion with the question of technical requirements it is interesting to know that the Committee of the Advertising Section intend to issue for the information of competitors a memorandum on Poster Designing, which, embodying, as it will, hints and advice on the subject by leading practical men in this profession, should prove of great value to students of Schools of Art and others entering for this Section of the Competition.

But whilst a number of the Judges have commented somewhat severely on the lack of technical knowledge shown by the candidates, several of those connected with the textile trade who took part in the adjudication of this year's designs expressed their surprise at the high standard of excellence of the work submitted. It was a revelation to them to find so much native talent available in the country and, in several instances where manufacturers had just returned from the Continent, they frankly admitted that many of the designs entered for the Competition were quite as good as those for which high prices were being charged abroad.

A feature of this year's Competition is the success of candidates from the overseas parts of the Empire. The prize offered by the Orient Line, for

a poster was won by an Australian ; two important prizes went to Canada, and a prize for typography to an Indian student.

For the benefit of those whose work is approved by the Judges for exhibition, a Bureau of Information has been opened by the Society, for the registration of the names of those exhibitors who desire to obtain employment as designers. The information is placed at the disposal of manufacturers, and a number of appointments have been made in this way. Mention has already been made of two of them, and a third great textile firm have intimated that they are going to offer a post to the winner of their first prize in this year's competition. Besides these, other appointments have been made through the Bureau, and many more have been made without being reported to the Society, as manufacturers and publicity agents in search of designers with new ideas visit the exhibition each year in order to note the names and addresses of designers likely to suit their purpose.

The Council desire to express their thanks to those firms and individuals who have provided the scholarships and prizes ; to the Judges who devoted much time and care to a very difficult task ; to the authorities of the Imperial College of Science and Technology who provided accommodation for the reception of the designs, and to Lieut.-General Sir William Furse, K.C.B., D.S.O., Director of the Imperial Institute, through whose kindness the Society received permission to judge the designs and to hold an exhibition of selected work in the Exhibition Pavilion of the Institute.

NUMBER OF ENTRIES.

The total number of competitors who entered for the various sections of the Competition was 1,219. Of these, 901 were students of Schools of Art, and 318 non-students.

The number (of mounts) of designs submitted was 3,669, divided as follows :—

ARCHITECTURAL DECORATION	..	..	..	..	276
TEXTILES	..	..	..	..	1,475
FURNITURE	..	..	..	..	227
BOOK PRODUCTION	..	..	..	..	139
POTTERY AND GLASS	..	..	..	..	263
ADVERTISING	..	..	..	..	1,289

TOTAL FOR ALL SECTIONS 3,669

REPORTS OF JUDGES.

ART CONGRESS STUDENTSHIP.

The Art Congress Studentship of the value of £50, was open, under the conditions of the Competition to any candidate in any Section. The Studentship was awarded by the Judges to:

Miss Vera Maud Miller, Royal College of Art, for her designs Nos. 1226-1231 in Sub-section 5, No. 1239 in Sub-section 7, and No. 1217 in Sub-section 1, in the Textile Section.

SECTION I.—ARCHITECTURAL DECORATION.

SUB-SECTION 1. *Prize offered by the Royal Society of Arts under the John Stock Trust for a Design for the Proscenium Wall of a Cinematograph Theatre. Competitors must not be over 30 years of age.*

The awards are as follows :—

The Prize of £50 to Frederick Ernest Woolley, Nottingham School of Art (No. 3037 and No. 3038).

Commended :

John Grisedale Sidebottom, Leeds College of Art. (No. 2177 and No. 2178)

The Judges are somewhat disappointed by the limited number of designs submitted, and in the still more restricted number of those which show adequate training for a subject of growing importance. This substantial prize should attract students of greater experience.

A common fault is incoherence of composition, a cramming together of disconnected and inharmonious styles

The student before beginning his work should inform himself carefully of the requirements involved. F. E. Woolley, to whom the prize is awarded, has done this. His design shows restraint, a sense of proportion and is a well-rendered drawing, undoubtedly the best submitted. He has realised that the decoration of the proscenium is subordinate to the main purpose of the building, which is the cinematograph itself.

SUB-SECTION 2. *Prize offered by the Royal Society of Arts under the Mulready Trust for a set of three black and white drawings of Architectural Subjects in any town or district.*

The awards are as follows :—

The Prize of £20 to Eric Frank Starling, Bartlett School of Architecture, University College (No. 1827).

Highly Commended :

Eric Frank Starling, Bartlett School of Architecture, University College (Nos. 1828 to 1835).

The general opinion of the Judges was that the Drawings in this Sub-section reached a high degree of excellence, the pencil drawings of London buildings, awarded the first prize, being of a very high standard indeed.

The author of the winning set should be encouraged to develop his skill. His work shows great promise but he should not allow his facility with the pencil to affect his studies as an architect.

SUB-SECTION 3. *Lewis Berger Scholarship of the value of £60, tenable at the Royal College of Art for a period of three months for the purpose of study in Decoration and Decorative Painting.*

The award is as follows :—

The Lewis Berger Scholarship of £60 to Carill John Hay Shaw, l'Ecole des Beaux Arts, Montreal. (Nos. 3656 to 3664).

The candidate has not been successful in interpreting the intention of the subject prescribed, and has failed to realise its full possibilities. With regard to colour, the green is not in keeping with the Adam period, being too harsh in tone, and, further, the condition that green was to be used was confined to the decoration for walls and ceilings. The polychromatic possibilities in the decoration of pilasters, entablature and mantelpiece have not been realised. The design for the ceiling, though neat in execution, is poor and incorrect in detail.



* St Mary le-Bow Church Pencil Drawing by Frank Starling (Bartlett School of Architecture, London University), awarded a prize of £20

* Reproduced from *The Architects' Journal*, August 21st, 1929

With regard to the "evidences of study," the Judges would have preferred sketches of historical or applied ornament.

In spite of these criticisms, however, the Judges have confidence in awarding the Scholarship as they feel that the candidate will derive much benefit from the course of study made possible by this Scholarship.

SUB-SECTION 4. *Prize offered by Messrs. Baguès, Ltd., for a design for a Decorative Metal Work Scheme for the Entrance Vestibule and the Main Entrance Hall of a Town Hall in an important maritime town.*

The awards are as follows :—

The Prize of £50 and an Owen Jones medal, to Leonard Whitaker, Leeds College of Art. (Nos. 2179 to 2184).

Highly Commended :

William Lewis Havard, Corsock, Stanley Avenue, Wembley. (Nos. 2491 to 2497).

The prize-winning design is good ; it displays a sense of composition and proportion and gives the effect of stateliness conforming to the requirements. It inclines, however, to over-much repetition of detail.

The designer is recommended to study the technical side of the metal craft.

W. L. Havard's design (Nos. 2491 to 2497) is graceful and attractive, but more suitable for a Restaurant or Emporium than for a Municipal Building. It displays a poetic conception as regards the design of the balcony railing (the wavy handrail, however, is unfortunate) and the lift gates.

The balustrade is too "copy book" in treatment and unsound from the practical point of view.

On the whole, the design lacks dignity and masculinity, but has a certain charm. The work in this Sub-Section was generally good and encouraging.

SUB-SECTION 5. *Prize offered by the British Commercial Gas Association for a Design for a Fire-place for a room and a Gas-fire of original design for use in connexion therewith.*

The Judges were unable to recommend that the full Prize of 50 Guineas should be given, but the following awards were made :—

A Prize of £31 10s. to Philip Evans Palmer, 19, Handside Lane, Welwyn Garden City. (No. 1741).

A Prize of £10 10s. each to the following :—

Francis William Mudd, Leeds College of Art. (No. 2186 and No. 2187)

James Henry Sellers, 78, King Street, Manchester. (No. 1271).

Commended :

John Breakwell, 35, Broadhurst Gardens, N.W.6. (No. 1361).

The problem of the gas-fire and its setting is so important that it is a little disappointing that only eleven designs were submitted. The solution proposed by Philip E. Palmer, who shows his gas-fire adapted to a new mantelpiece and to an old fireplace, shows careful thought and refreshing evidence of the fact that a gas-fire is something distinct from a coal-fire and demanding a modern note in its fashioning. F. W. Mudd and J. Henry Sellers have submitted some very good designs in a more conventional manner.

SUB-SECTION 6. *Prizes offered by the South Metropolitan Gas Company for (a) a Grate Front only of modern design, (b) a modern Fireplace to include a Metro Coke Grate, (c) a self-contained Fire for solid fuel incorporating the principles of the Metro Coke Grate, and (d) a Basket Grate incorporating the principles of the Metro Coke Grate.*

The awards are as follows :—

A Prize of £26 5s. to Frederick George Laming, 105, Drummond Road, S.E.16. (No. 484).

A Prize of £10 10s. to Frederick Rueben McCree, 33, Fenwick Road, S.E.15. (No. 917 and No. 918).

Commended :

Frederick George Laming, 105, Drummond Road, S.E.16. (No. 481, No. 482 and No. 483).

This Sub-Section proved disappointing. Only seven entries were received from three competitors, and the designs showed no outstanding originality or artistic merit. Four prizes were offered, but in view of the few entries the Judges were only able to award two. F. G. Laming submitted designs in all four divisions of this Sub-Section, the four designs being all modifications of one basic idea. Although the treatment was satisfactory, more regard might have been paid to cost of production and to economy of labour in maintenance. F. R. McCree's two designs for a coke grate front, although they were little more than detail modifications of existing designs, have sufficient merit, in view of the youth of the candidate, to deserve encouragement.

SUB-SECTION 7 (a). Prizes offered by Messrs. Morris and Co. (Westminster), Ltd., for a design for a Staircase Window in a modern Departmental Store.

The awards are as follows :—

Highly Commended :

Miss Isobel T. M. Goudie, 4, Royal Gardens, Stirling. (No. 1899).

Commended :

Miss Maureen Stoddart, Nottingham School of Art. (No. 3028 and No. 3029).

Miss I. T. Goudie's design (No. 1899) is good in general lay-out, but the dark grey glass would be unsatisfactory for the purpose. Miss M. Stoddart's designs (Nos. 3028 and 3029), and J. R. Sime's design (No. 541) show a good knowledge of material and construction.

SUB-SECTION 7 (b). Prizes offered by Messrs. Morris and Co. (Westminster), Ltd., for a design for a range of six windows for a Restaurant in a large city.

The awards are as follows :—

The First Prize of £10 10s. to John Hammond Harwood, A.R.C.A. (Lond.), School of Art and Crafts, West Marlands, Southampton. (No. 1960 and No. 1961).

The Second Prize of £5 5s. to Arthur Edward Buss, 9, Lutwyche Road, S.E.6. (Nos. 643 to 648).

Commended :

John Roger Sime, Nottingham School of Art. (No. 541).

The Judges regret the fewness of competing designs for an important craft. The rejected designs show to a marked extent the want of practical knowledge of the craft. Design No. 3030 shows invention, but not practical knowledge of the craft.

J. H. Harwood's design (Nos. 1960 and 1961) shows well-designed windows of simple construction, a knowledge of materials and their possibilities, and is, with the exception of figure panels, well drawn and composed.

A. E. Buss's design (Nos. 643 to 648) is too small in scale, but would work out satisfactorily in larger windows; the drawing and colour are good and the design shows decorative sense.

SUB-SECTION 8. *Prize offered by Mr. G. Paget Walford (Past Master of the Worshipful Company of Glaziers and Founder of the Walford Fund of that Company) for the best small Window or Medallion painted and glazed from an original design. Open to students and apprentices not exceeding 25 years of age.*

The awards are as follows :—

The Prize of £26 5s. to Miss Jean M. B. Paisley, Edinburgh College of Art, (No. 3444).

Highly Commended :

Walter J. R. Cook, Edinburgh College of Art (No. 3418).

Commended :

Henry John Hunt, South London Art School. (Nos. 1414 and 1415 and Nos. 1416 and 1417).



*Winter. Painted window by Miss Jean Paisley (Edinburgh College of Art).

The Judges are pleased to express their great satisfaction with the excellent work submitted in this Sub-Section.

Although only four panels were sent in, it was hardly to be expected that many students would be in a position to incur the expense of producing the finished work.

* Reproduced from *The Architects' Journal*, August 21st, 1929.

Miss Jean M. Paisley's panel (No. 3444), which is awarded the prize, is excellent in design, workmanship and colour, in which W. J. R. Cook's panel (No. 3418) follows it very closely.

Nos. 1416-7, by H. J. Hunt, is quiet and restrained in colour, and the draughtsmanship is of a high order. Nos. 1414-5, by the same competitor, shows also great care and good drawing, though perhaps there is a little too much detail.

SUB-SECTION 9. *Prizes offered by the Malkin Tiles (Burslem), Ltd., for Designs for an all-tile and faience Fireplace, suitable for an entrance hall, lounge or dining room*

The awards are as follows :—

A Prize of £17 10s. to Miss Edith Lois Martin, 8, Chester Road, Branksome Park, Bournemouth. (No. 103).

The second prize was not awarded. Several of the designs failed because, in the opinion of the Judges, they would be too difficult to reproduce owing to the large number of moulds required. Others failed because they did not indicate any period, as required by the conditions of the competition.

SUB-SECTION 10. *Prizes offered by the London and North Eastern Railway Company for design of (a) a First Class Railway Compartment, (b) a Third Class Railway Compartment.*

The awards are as follows :—

The First Prize of £25 to Richard Alfred Simons, c/o The Midland Bank, Ltd., Market Place, Leicester. (Nos. 1552 to 1554).

The Second Prize of £15 to Edward Thomas Ashmore Houldcroft, A.M.I.Mech.E., 341, Haydn Road, Nottingham. (Nos. 1320 and 1321).

Many of the entrants have failed to grasp the essentials, and have not displayed originality or inventive talent. The lines are too conventional and a failure to force the perpendicular lines is marked in most designs. The winning design, however, was a departure from tradition, and shows originality and cleverness, especially in its colour scheme. This design also has a certain amount of good minor features, such as electrical fittings, luggage racks, etc.

The second prize is given to E. T. A. Houldcroft. The design that he has shown for a Third Class Compartment is considered preferable to his design for the First Class. He has shown originality in his electrical fittings and the disposition and arrangement of his minor features.

SECTION II.—TEXTILES.

SUB-SECTION 1. *A Travelling Studentship of £75 offered by the Tootal Broadhurst Lee Company, Limited, for a set of at least eight designs suitable for weaving or printing intended for Dress or Furnishing Materials. Competitors must not be more than 24 years of age.*

The Travelling Studentship of £75 offered by the Tootal Broadhurst Lee Company is awarded to :—

Norman Wilkinson, Manchester School of Art. (Nos. 3223, 3225, 3226, 3229, 3231 to 3234).

The following awards are also made :—

A Royal Society of Arts Prize of £10 and an Owen Jones Medal to Miss Anne Ethel Martin, Royal College of Art. (No. 1512 and No. 1514).

A Royal Society of Arts Prize of £3 to Miss Vera Maud Moller, Royal College of Art. (No. 1217).

Commended:

Miss Angela Bradshaw, Manchester School of Art. (No. 975).

Miss Betty Heesom, L.C.C. Central School of Arts and Crafts. (No. 1150).

Stanley James Robert Leeming, 14, Colne Road, Halstead, Essex. (No. 1165).

The competition, apart from the prize-winning designs, is disappointing, especially in comparison with that of two years ago.

More attention should be paid to balance of composition and finishing the design in a practical way. The Judges would again call special attention to the criticism contained in their report of last year:—"Extravagance in design is not necessarily originality and ingenious simplicity is not sufficiently considered. Further, fine taste in colour is wanted rather than multiplicity of colours in one scheme, and several designs, good in form, suffered from poor distribution and choice of colour."

The winner of last year's studentship, Miss Barbara Lebkuchen, has submitted an interesting set of designs.

SUB-SECTION 2. Prizes offered by British Celanese, Limited, for designs for printing Silk Fabrics for Dress Wear.

The awards are as follows.

The First Prize of £15 to Frank Grimshaw, 11, St. Patrice Street, Magog, Quebec, Canada. (No. 53 (a)).

The Second Prize of £6 to Miss Janet Dean, Royal College of Art. (No. 220)

An extra Prize of £5 to Arthur Hurman Hardstaff, Nottingham Correspondence College for Applied Designs. (No. 1975).

Highly Commended:

Miss Dorothy Cartmell, Manchester School of Art. (No. 3474).

Miss Marian Forrest, Glasgow School of Art. (No. 3052).

Frank Grimshaw, 11, St. Patrice Street, Magog, Quebec, Canada. (No. 53 (b)).

Miss Barbara Lebkuchen, Slade School of Art. (No. 1459).

Fred Marsden, Glossop School of Art. (No. 2260).

Commended:

Victor Roy Brown, L.C.C. Hammersmith School of Arts and Crafts. (No. 364 and No. 365).

Mrs. Dorothy Clark, Bournemouth School of Art. (No. 2734 and No. 2736).

Miss Ivy Gwendoline Collyer, Royal College of Art. (No. 329).

Miss Mary Doreen Cooper, Royal College of Art. (No. 326).

Frank Grimshaw, 11, St. Patrice Street, Magog, Quebec, Canada. (No. 53 (c)).

Miss Florence Greenwood, Rochdale School of Art. (No. 2816).

Harold Hemingway, Rochdale School of Art. (No. 2835).

Miss Barbara Jamieson Cochrane Highet, Glasgow School of Art. (No. 3054).

Miss Freda Mary Honour, Liverpool School of Art. (No. 3527).

Miss Barbara Lebkuchen, Slade School of Art. (Nos. 1460 to 1462).

Harold Lecanski, Salford School of Art. (No. 1442).

Fred Marsden, Glossop School of Art. (No. 2263).

Miss Cicely Janet Mary Mason, Ruskin School of Drawing, Oxford. (No. 920).

Miss Mildred Ogden, 136, Burnage Lane, Levenshulme, Manchester. (No. 799 and No. 802).

Miss Alice Daisy Parkin, 75, Forest Road West, Nottingham. (No. 1339).

Miss Erica Margaret Payne, Manchester School of Art. (No. 3171).

Miss Doris Dale Pratt, Manchester School of Art. (No. 3193).

Miss Jean Marie Vaughan, 47, Belsize Square, N.W.3. (No. 1276).

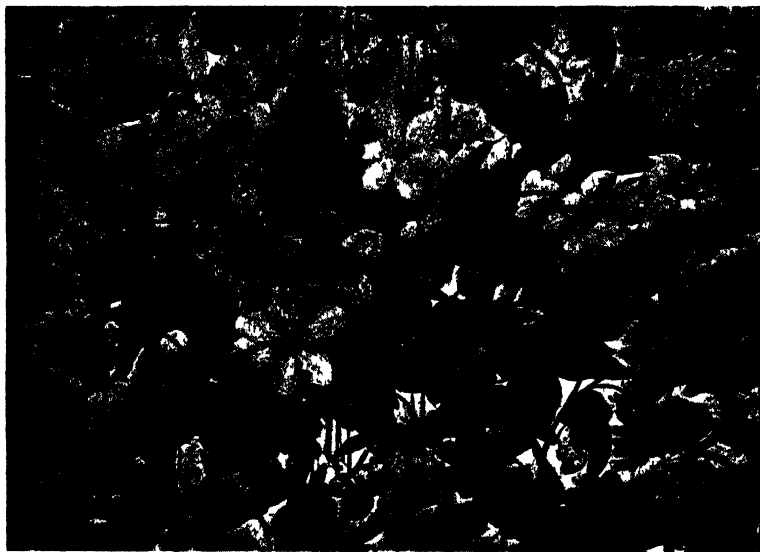
Harold Watson, 12, High Street, Ware, Herts. (No. 1759).

William Walker Watson, 40, Cranbrook Road, Gorton, Manchester. (No. 188).
George William Willis, 43, Caesars Walk, Cranmer Estate, Mitcham, Surrey.
(No. 1307).

In view of the large number of entries in this Sub-Section (323) and the excellence of the best, it was decided to award a Third Prize of £5, in addition to the two prizes which were originally offered

From an inspection of the designs as a whole, it was very noticeable that, apart from prize-winners and those highly commended, competitors, whilst frequently displaying *artistic* merit, showed a lack of acquaintance with present-day fashion and tendencies for women's dresses

The colourings chosen for the sketches were frequently unfortunate, and competitors should endeavour to cultivate a better feeling for colour The water colour paints almost invariably used do not flatter the designs as much as the heavier pigment used by continental designers



* Design for cretonne by Mrs Kathleen H. Sargeant awarded the first prize in Sub-Section (3) of the Textile Section

SUB-SECTION 3 Prizes offered by Messrs Simpson and Godlee Ltd, for Designs for Cretonne

The awards are as follows -

The First Prize of Thirty Guineas to Mrs Kathleen Hamilton Sargeant, Eaglehurst, Douglas Isle of Man (No 277)

The Second Prize of Twenty-five Guineas and an Owen Jones Medal to Miss Margaret Rae Crow, Edinburgh College of Art (No 3420)

The Third Prize of Twenty Guineas to Ronald Stephen McArthur, Edinburgh College of Art (No 3432)

* Reproduced from *The Cabinet Maker*, September 7th, 1929



* Design for cretonne (highly commended) by Miss Vera M. Moller who was awarded the Art Congress Studentship.

The Fourth Prize of Fifteen Guineas to Mrs Marjorie Reynolds, 112, Gordon Road, Camberley, Surrey. (No. 1981).

The Fifth Prize of Ten Guineas to Alfred Edward Stenlake, 32, Victoria Road, N.W.1. (No. 1714).

Highly Commended :

Miss Vera Maud Moller, Royal College of Art. (No. 1224).

Miss Cecil Helen Wood, L.C.C. Central School of Arts and Crafts. (No. 1770).

Commended :

Miss Margaret Crees, Swindon School of Art (No. 2331).

Miss Betty Whitson Gifford, Goldsmiths' College School of Art. (No. 774).

The entries in this Sub-Section were numerous and contained much work of merit. The designs kept to the required specification and showed a pleasing advance on the standards of previous years. In a number of cases, however, there was not much freshness of treatment, and competitors should be warned that, whilst due regard must be paid to tradition, it is hopeless to continue to exploit out-worn formulæ.

The Judges were glad to be able to award all five prizes, and to make two awards of "highly commended" and two of "commended."

SUB-SECTION 4. *Prizes offered by Messrs. Turnbull and Stockdale, Ltd., for the two most original designs intended for machine-printed or hand-block-printed Cotton or Linen. Open to students, or designers serving apprenticeship, not exceeding 24*

The awards are as follows :—

The First Prize of £15 to Alexis Dods Revolta, Jun., Edinburgh College of Art. (No. 3448).

The Second Prize of £10 to Miss Betty Heesom, L.C.C. Central School of Arts and Crafts. (No. 1153).

Highly Commended :

William Stewart Kennedy Smith, Edinburgh College of Art. (No. 3454).

Miss Phyllis Mary Steanes Willis, Royal College of Art. (No. 1292).

Commended :

Miss Gladys Atkinson Brailsford, Battersea Polytechnic School of Art. (No. 2536).

Miss Barbara Grace Morgan, L.C.C. Central School of Arts and Crafts. (No. 349).

William Thomson Russell, Glasgow School of Art. (No. 3093).

Miss Doris Stell, Royal College of Art. (No. 360).

Miss Margaret Dun-Waters Tennant, Glasgow School of Art. (No. 3073).

Miss Dorothy Willington, Liverpool City School of Art. (No. 3587).

This was a very large, but, on the whole, a disappointing competition, there being very little which was suitable for cotton or linen prints. There was disclosed a too general tendency towards extravagant pictorial motives. The judges regret that too little interest was shown for plant form and that when used this was either simply reminiscent or a copy of an exotic continental type of design. They strongly advise a closer study of nature.

SUB-SECTION 5. *Prizes offered by Messrs. Warner and Sons, Ltd., for sets of six Designs for Printed Furnishings—the designs to be of natural flowers for use in small rooms.*

The awards are as follows :—

A First Prize of £30 to Miss Vera Maud Moller, Royal College of Art. (Nos. 1226-1231).

A Second Prize of £25 to Miss Esme Caton, Croydon School of Art. (Nos. 2048-2053).

A Third Prize of £20 to Miss Ethel Mary Pierpoint Sexton, 4, Risbygate Street, Bury St. Edmunds, Suffolk. (Nos. 547-552).

Highly Commended :

Thomas James Corbin, Royal College of Art. (No. 1372).

Miss Elsie Frederica Horn, Goldsmiths' College School of Art. (No. 887).

Miss Barbara Eva Lebkuchen, Slade School of Art. (No. 1479).

Miss Ena Mary Winkley, St. Helise, Woodside Avenue, N.10 (No. 1301).

Commended :

Miss Ivy Gwendoline Collyer, Royal College of Art. (No. 333).

Miss Ena Muriel Russell Higson, 27a. Ebury Street, S.W.1. (No. 1129 and No. 1130).

Miss Margaret Louise Parr, Manchester School of Art. (No. 3170)

William Thomson Russell, Glasgow School of Art. (No. 3101).

On the whole, the judges are satisfied with the works sent in for these prizes. Students are showing better appreciation of the capacities of the printing machine,

and the Judges are pleased to see that originality has been rather stimulated than otherwise by taking the necessary limitations into account.

The stipulation that the designs for these prizes were to be "of natural flowers for use in small rooms" provides sufficient explanation of the suggestion of monotony which otherwise might be judged to be a defect in considering the whole group of works submitted. Some limitation in the scale of the designs was also implied in the requirement that they should be suitable for use in small rooms. Bearing these circumstances in mind, the Judges have selected Miss V. M. Moller's design (No. 1226) for the first award; but as the prize was to be given for the set of six designs and the standard is not maintained in the other five works submitted by this student, the Judges have decided to take advantage of the discretion reserved to them. They make an award of £30 in this instance, instead of £50, and they constitute a third prize of £20 with the balance left over. The design selected for the first award shows an effective grouping of natural forms, aided by skilful distribution of colour.

The second prize of £25 is awarded to Miss Esmé Caton's designs (Nos. 2048-2053). The standard is here better maintained in all the six works submitted, and the terms of the competition are carefully observed. The colour schemes tend to err on the side of dullness, and with a brighter background the key would need to be raised throughout.

The third prize of £20 is awarded to Miss E. M. P. Sexton's designs (Nos. 547-552). The designs submitted by this student are somewhat more conventionalised, but not beyond the limits laid down. The best of the six is No. 552, which is admirably balanced, both as regards composition and colour.

No. 1372, by T. J. Corbin, is highly commended, though it strays from the conditions of the award. The design is one of the most original in the whole group.

No. 1301, by Miss E. M. Winkley, is also highly commended. It recalls the floral designs of a generation ago, but the treatment of the background redeems it from the suspicion of being merely old-fashioned.

No. 1479, by Miss Barbara Lebkuchen, is highly commended for vitality in design and harmony in colour.

No. 887, by Miss E. F. Horn, gains equal commendation, though the larger scale of the design would tend to dwarf a small room, and the thinness of the colouring would have a monotonous effect.

The work of Miss I. G. Collyer (No. 333) is commended for merit in arrangement of motive and colouring.

Other designs commended are No. 3100 by W. T. Russell, Nos. 1129 and 1130 by Miss E. M. R. Higson, and No. 3170 by Miss M. L. Parr. No. 3100 has decided originality. In No. 1129 a suggestion of landscape is imparted without loss to the design as a whole. No. 1130 shows a successful grouping of natural floral motives, but the colouring is somewhat weak. The arrangement of the motives in No. 3170 is skilful, but the conventionalisation hardly brings it within the terms of the competition.

SUB-SECTION 6. *Prize offered by Messrs. G. P. and J. Baker, Ltd., for a design suitable for Hangings—the subject of the design to be inspired from Spanish embossed leather work.*

The awards are as follows:—

A Prize of 20 Guineas each to

Miss Marian Graham, Royal School of Needlework (No. 1394), and

Miss Leonora Kathleen Silver, Royal School of Needlework. (No. 1269).

Highly Commended :

Miss Freda Maxwell, Manchester School of Art. (No. 3158).

Commended :

Miss Edith Louisa Vaughan Ailsby, 45, Seagrave Road, Fulham, S.W.6. (No. 1804).

Miss Ida Marion Dight, Brackley, Crofton Lane, Orpington. (No. 625).

Miss Rosalie Handley, L.C.C. Central School of Arts and Crafts. (No. 893).

The stipulation that the designs in this Sub-Section should be suitable for hangings "to be inspired from Spanish embossed leather work" may have led to some little misconception as to what was really meant. However, taken as a whole, the designs show an appreciation of the subdued brilliancy of lacquered and embossed leather when used for wall-hangings or screens.

As two designs appeared to be of equal merit, Messrs. G. P. & J. Baker generously increased the amount of the prize money from 25 to 40 guineas, which has enabled the Judges to award two prizes of 20 guineas each to Miss M. Graham (No. 1394) and Miss L. K. Silver (No. 1269). No. 1394 approaches more nearly to the terms of the competition than any other design submitted, and it is adaptable for reproduction. The blue canopy is perhaps a little over-accentuated for a repeating pattern.

No. 1269 shows qualities of design not seen elsewhere in this group. The natural treatment of the flowers is happily combined with formal motives.

No. 3158, by Miss Freda Maxwell, is highly commended. It is perhaps the most modern and original design in the group. But for a lack of emphasis in the colour scheme it would have earned a higher award.

Miss R. Handley's design, No. 893, is commended. With a little more pains it might have been admirable. As it is the design tends to fall to pieces through lack of a central idea, and the colour scheme has similar drawbacks.

Miss I. M. Dight's design (No. 625) shows a sense of form and colour which is also to be commended. No. 1804, by Miss E. L. V. Ailsby, is commended for praiseworthy treatment in a modern way. The designs submitted in this Sub-Section tend to show more concentration on pattern than on colour. It may be that the students have had in mind the mellow effect of old leather without associating with it the lively colouring often used in such decoration.

SUB-SECTION 7. *Prizes offered by Messrs. Courtaulds, Ltd., for sets of twelve Designs for Plain and Figured Furnishing Fabrics.*

The Judges were unable to recommend that the full Prizes should be given, but the following awards were made :—

A Prize of £10 each to the following :—

Miss Vera Maud Moller, Royal College of Art. (No. 1239).

Donald Lewis Rayner, Manchester School of Art. (No. 519).

The Judges are disappointed with the small number of designs submitted. The work generally shows lack of technical knowledge, which possibly accounts for so small an entry.

SUB-SECTION 8. *Prizes offered by Messrs. Lister and Co., Ltd., for Designs suitable for (a) Figured Moquette for Furniture Covering, (b) Furnishing Damask, and (c) Shaft Furnishing Moquette.*

The Judges were unable to recommend that the full Prizes should be given, but the following award was made :—

A Prize of £10 to Joe Moore, International Correspondence Schools, Ltd. (No. 119).

In Figured Moquettes none of the designs submitted were considered of sufficient merit or originality to warrant the award of a prize.

In Damask, while none of the four designs submitted were outstanding in style or originality, J. Moore's design was considered to merit recognition.

In Shaft Moquette only one design was submitted, and this did not fulfil the conditions specified, and was not practical for weaving on a shaft loom.

The Judges regret the extremely small number of designs submitted for all the divisions of this Sub-Section. They feel that this may be due to lack of technical knowledge of this class of woven fabrics and suggest it would be of considerable value if more instruction could be given on weaving conditions and the construction of these classes of fabrics which are of considerable importance in the furnishing trade.

If this could be done, they feel sure that entries would be largely increased and a higher standard obtained.

SUB-SECTION 9. *Prizes offered by Messrs. Brintons, Ltd., for a Design for a Wilton or Axminster Carpet suitable for a Theatre, Showroom, or Hotel.*

The Judges were unable to recommend that the full Prizes should be given, but the following awards were made :—

A First Prize of £12 to Walter Shepherd, Kidderminster School of Art. (Nos. 2793 and 2794.)

A Second Prize of £10 to Walter Shepherd, Kidderminster School of Art. (Nos. 2795 and 2796.)

A Third Prize of £8 to Frank Victor Rogers, Kidderminster School of Art. (Nos. 2791 and 2792.)

Highly Commended :

Mis Vera Maud Moller, Royal College of Art. (Nos. 1245 and 1246.)

Commended :

Frank William Evans, Kidderminster School of Art. (Nos. 2759, 2760, 2761 and 2762.)

Herbert Gordon Fry, 1179, King Street West, Toronto, Ontario, Canada. (Nos. 41 and 42.)

Charles Robert Millward, Kidderminster School of Art. (Nos. 2779 and 2780.)

George Graham Quick, Kidderminster School of Art. (Nos. 2787 and 2788.)

The works submitted in this group reach a fair average level, but the Judges are unable to single out any one design as meriting the First Prize of £20. The sum is, therefore, divided. On the whole, W. Shepherd's design Nos. 2793/4 appears the best. The effect of the main design is somewhat frittered away by borrowing so much from it in the composition of the border, and more colours are used than are warranted by the effect arrived at.

The Second Prize is awarded to the same student's design Nos. 2795/6. The variety of motive combined with relatively few colours is much to be commended and the colour scheme is easily susceptible of variation. On the other hand, the border is too crowded and the scale is unduly small when compared with the main design.

A third prize is given to F. V. Rogers's design Nos. 2791/2. The composition of the main design is happy. It would require an unusually fine texture, but not beyond practicable limits. The colour scheme is good.

Nos. 1245/6 by Miss V. M. Moller is highly commended. It shows vitality and the balance of the main pattern and border is good. The skilful use of few colours is also to be noticed.

Nos. 2779/80, by F. W. Evans, is commended as a very practical design. The limitations of the fabric are well regarded, and the colour scheme could be varied if required without detriment to the pattern. Nos. 2787/8, by G. G. Quick, is also commended for general qualities of design and colour, though the tapering lines used here and there would not be practicable for the loom. A similar criticism may be passed on Nos. 2759/60, which is also commended. Some of the lines are too fine. Nos. 41/2, by H. G. Fry, is commended as a well-balanced design in the modern manner. Another design of modern tendencies is Nos. 2761/2, by F. W. Evans. It is commended for the effective combination of straight lines with floral motives.

SUB-SECTION 10. *Prizes offered by Messrs. John Crossley and Sons, Ltd., for a Design (a) for an Axminster Carpet suitable for a Drawing Room, (b) for a Wilton Carpet suitable for a Drawing Room.*

(a) The Judges were unable to recommend that the full amount of the Prizes should be given, but the following awards were made :

A First Prize of £10 to Geoffrey Isaac Foreman, 11, Westgate, Halifax. (Nos. 876 and 877.)

A Second Prize of £5 each to Frank Heaton, Elder Bank, Walsden, Near Todmorden, Lancs. (Nos. 249 to 251).

Albert George Phipps, Kidderminster School of Art. (Nos. 2783 and 2784). Commended :

Herbert Richmond, Halifax School of Art. (Nos. 2596 and 2597).

(b) The awards are as follows :—

The First Prize of £20 to Walter Shepherd, Kidderminster School of Art. (Nos. 2799 and 2800)

Commended :

Harold J. Watkins, 144, Park Street, Kidderminster. (No. 968).

The entry was small for both divisions of this group, presumably because some acquaintance with the technique of carpet-weaving by machinery was involved. The designs submitted were disappointing as a whole. Even among so few there were several which would not be easily adaptable to the requirements of the loom.

In Division (a) of this Sub-Section, the work showing most merit is G. I. Foreman's design Nos. 876/7. It is thought that the sickle-shaped curve of the chief figure in the design would gain too much emphasis by repetition over a large surface. Nevertheless, the treatment of the background with mountainous landscape and water lilies is well in harmony with the rococo suggestion of the main motive. The colouring is good and the design practicable. A. G. Phipps's design Nos. 2783/4 shows imagination in design, though the distribution of the colours might have been simplified without corresponding loss of effectiveness. F. Heaton's design Nos. 249/51 is meritorious as a whole, but the cloud and water motive of the border does not seem altogether in harmony with the central pattern, and the colouring has a parched effect.

Nos. 2596/7, by H. Richmond, shows promise and is highly commended. The formality of the background is a good foil to the main design.

In Division (b) W. Shepherd's design Nos. 2799/2800 receives the First Prize. The Chinese inspiration of this design is obvious, but it is interpreted with imagination and an appreciation of the public requirements at the present day. This design is the outcome of a more "practical" outlook than is shown in the other works submitted in this group.

A second prize is not awarded as no other work reaches the required standard.

No. 968, by H. J. Watkins, is commended for originality in design, but there

is a tendency to a harsh note in the colour scheme, which might, moreover, be liable to be less pleasing under artificial light.

SUB-SECTION 11. *Prizes offered by Messrs. Tomkinsons, Ltd., for a Design for an Axminster Carpet showing indications of Chinese influence suitable for a Drawing Room.*

The Judges were unable to recommend that the full amount of the Prizes should be given, but the following awards were made :—

A First Prize of £10 to Frederick Enoch Raymond Everley, Kidderminster School of Art. (Nos. 2765 and 2766.)

A Second Prize of £5 to William Eric Phillips, Kidderminster School of Art. (Nos. 2781 and 2782).

A Third Prize of £3 to David Edgar Morris, Kidderminster School of Art. (Nos. 2777 and 2778).

The entry was poor and the quality not good enough for a recommendation for the full amount of the first prize. The competitors do not seem to have much idea of Chinese carpets either in colour or design, and the entries seem more inspired by prints or embroidery or even by western fabrics of a Chinese style. F. E. R. Everley's design Nos. 2765/6 would be better if the ground were brighter, but the pattern is well adapted for a repeat. W. E. Phillips's design Nos. 2781/2 is more like a chintz than a carpet in design. D. E. Morris's design Nos. 2777/8 would be better if the ground were a Chinese yellow.

SUB SECTION 12. *Prizes offered by Messrs. Harold Finlinson, Ltd., for two sets of Designs (each consisting of three colour schemes) suitable for Oriental Carpets.*

The Judges were unable to recommend that the full amount of the Prizes should be given, but the following award was made :—

A Prize of £10 10s. to Miss Margaret Ellen Hays, The Mythe, Bognor. (Nos. 775 to 780).

The entries in this Sub-Section were disappointing, both in number and quality. The competition called for treatment in Oriental styles. The results have shown failure in this respect, save in the case of Miss M. E. Hays, who has shown some feeling and appreciation for the Oriental style. Her work possesses originality and shows perception. It would have been better if she had treated the field of the carpet with some pattern work instead of leaving it so plain.

SUB-SECTION 13. *Prize offered by the late Mrs. Lewis Foreman Day for a Design for a panel of Embroidery.*

The awards are as follows :—

The Prize of £10 to Mrs. Agnes Hoad, 142, Kingshall Road, Beckenham, Kent. (No. 343).

A Royal Society of Arts Prize of £3 3s. to Miss Muriel Walker, Manchester School of Art. (No. 3221).

Highly Commended :

Miss Nancy Guest, Manchester School of Art. (No. 3120).

Miss Sheila Margaret Knox, Manchester School of Art. (No. 3130).

Commended :

Miss Gladys Atkinson Brailsford, Battersea Polytechnic School of Art. (No. 2534).

Miss Lena Elizabeth Cole Northampton School of Arts and Crafts. (No. 2217).

Miss Phyllis Joyce Walkey, Northampton School of Arts and Crafts. (No. 2219).

There was a good entry for this competition, but the standard was not as high as last year. Many of the designs were too weak or too conventional, and only a few show real originality. An adaptation of an old design cannot be called original, and aniline colours should not be confused with bright colours. Nursery subjects and art needlework were also in evidence, but had no distinctive qualities. The first prize subject is carefully designed, both for composition and workmanship. The second prize is an original subject and some of those commended are also modern and well conceived. It is this modern and original note in these entries which makes this competition a distinct success.

SUB-SECTION 14. *Prizes offered by Messrs. A. Herbert Woolley and Co., Ltd., for (a) a Design for a Lace Flounce and (b) for a set of Designs suitable for trimming Ladies' Underclothing to be made on Lever's Lace Machine.*

The awards are as follows :—

(a) A First Prize of £8 to William Rowland, Nottingham School of Art. (No. 3017).

A Second Prize of £5 to William Guildford Martin, Nottingham School of Art. (No. 3009).

(b) A First Prize of £5 to Geoffrey Ross Dearden, Nottingham School of Art. (No. 2997).

A Second Prize of £2 to Miss Winifred E. Bexton, Nottingham School of Art. (No. 3468).

It is to be regretted that there was not a greater number of designs, although several of those submitted show considerable originality. The flounce design which receives the first prize indicates a good practical knowledge of the technical processes, and that to which the second prize is awarded has originality. Among the designs for trimming underclothing that obtaining the first prize has distinct character; the second prize is given to a design graceful in treatment, although it presents certain difficulties in execution.

SECTION III.—FURNITURE.

SUB-SECTION 1. *Prizes offered by the Royal Society of Arts for Designs for a Scheme for the complete Decoration and Furnishing of a Middle-class Bedroom. The treatment to be essentially modern in character, particular attention being paid to utility and convenience.*

The Judges were unable to recommend that the full amount of the prizes should be given, but the following awards were made :—

A First Prize of £15 to Harold John William Hyde, 8, Vernon Terrace, Bath. (No. 247 and No. 248).

Two Second Prizes of £10 each to :

Frederick Norman Cater, Westminster Technical Institute. (No. 1599 and No. 1600).

Cyril Leslie Charles White, Nottingham School of Art. (No. 3039 and No. 3040).

Highly Commended :

George Beaumont, 5, Hungerford Road, Edgerton, Huddersfield. (Nos. 1993 to 1996).

Arthur Edward Harvey, A.R.C.A. (Lond.), 7, Flat, Southdown Avenue, South Road, Handsworth, Birmingham. (Nos. 63 to 68).

Commended :

Maurice Godden, L.C.C. School of Building. (Nos. 634 to 636).

Frank Leslie Keep, High Wycombe School of Art. (No. 2100 and No. 2101).

Basil Procter, Crichton Hall, Dumfries. (No. 1922 and No. 1923).

Donald Milne Williamson, Sheffield College of Arts and Crafts. (Nos. 2908 to 2912).

The Judges were glad to note a general and serious attempt to tackle the conditions of the competition. They admire the industry and enthusiasm which must have been expended in the preparation of the drawings, many of which were well executed and workmanlike. On the other hand, the Judges regret that no one competitor reached a standard which justified the full award. Too much attention has been given to unnecessary detail or superfluous ornament. Design No. 247, for which the first prize was awarded, is spacious in planning though lacking in wardrobe accommodation. The Judges feel that there is still ample room for improvement in the right understanding of design in relation to material and space.

SUB-SECTION 2. Prizes offered by the Royal Society of Arts for Designs for an Office Desk Chair of the revolving type, to cost about £12.

The awards are as follows : —

The First Prize of £10 to George Francis Bungay, 10, Hardenwaye, Totteridge, High Wycombe, Bucks. (No. 992).

A Prize of £2 10s. to John Frederick Mole, High Wycombe School of Art. (No. 2108).

The Judges considered that No. 992 was an exceptionally good design, worthy of the full prize and deserving of special commendation. The drawing was also very crisp and clear.

SUB-SECTION 3. Prizes offered by the London Cabinet and Upholstery Trades Federation for Designs for Dining Table, Dining Room Chairs and Sideboard in a restrained modern style.

The awards are as follows :—

A First Prize of £15 to Edwin Lewis Clinch, High Wycombe School of Art. (No. 2090 and No. 2091).

Two Second Prizes of £5 each to :

Albert Ronald Liddicoat, Shoreditch Technical Institute (No. 1195 and No. 1196).

George Stirling, c/o Fergusson, 4, Holmfauldhead Drive, Govan, Glasgow. (No. 1727 and No. 1728).

Highly Commended :

Duncan McCallum Grassie, 14, Blythswood Terrace, Sandy Road, Renfrew. (Nos. 1910 and 1911 and Nos. 1912 and 1913).

Miss Diana Helen Woolston, Student of Mr. J. H. Roberts, 30, Royal Crescent, W.11. (No. 2509 and No. 2510).

The designs as a whole show too much insistence upon " Monolithic " motives without due regard for the practical use of sideboards and tables.

The Judges do not consider that there is a sufficiently wide margin of merit between the first and the bracketed second prizes to justify the full award of £20 for the first prize, and have, therefore, reduced the amount to £15, in order to provide two second prizes of £5 each.

In awarding the first prize to E. L. Clinch's designs (Nos. 2090 and 2091), the Judges have had more regard for the finished design than pictorial draughtsmanship. The sideboard shows good proportion and useful arrangement, the chairs have

pleasing proportions and shapes and the restrained character of all the designs is to be encouraged.

With regard to designs Nos. 1195 and 1196 by A. R. Liddicoat, and Nos. 1727 and 1728 by G. Stirling, which the Judges consider should be bracketed together for second prizes, they have specially considered the practical and useful character of the designs and have borne in mind that both sets of designs lend themselves to economic production.

SUB-SECTION 4 (a). Prize offered by Venesta, Ltd., for a Design for a Plywood or Plymax (metal-faced plywood) Wireless Cabinet.

The awards are as follows:—

A Prize of £5 to Philip Evans Palmer, 19, Handside Lane, Welwyn Garden City. (No. 1743).

Commended:

George Francis Bungay, 16, Hardenwaye, Totteridge, High Wycombe, Bucks. (No. 995).

SUB-SECTION 4 (b). Prize offered by Venesta, Ltd., for a Design for a Plywood Sideboard.

The awards are as follows:—

A Prize of £10 to George Francis Bungay, 16, Hardenwaye, Totteridge, High Wycombe, Bucks. (No. 996).

Highly Commended:

Eugene Welch, 40, Christ Church Gardens, Lichfield, Staffs. (No. 1772).

Commended:

Thomas Lees, 5, Russell Cottages, Broadway, Worcs. (No. 260).

SUB-SECTION 4 (c). Prize offered by Venesta, Ltd., for a Design for a Plymax Sideboard or Desk.

The awards are as follows:—

A Prize of £10 to William Henry Russell, c/o W. Stanley, Leamington Road, Broadway, Worcs. (No. 1695).

Highly Commended:

Eugene Welch, 40, Christ Church Gardens, Lichfield, Staffs. (No. 1773).

SUB-SECTION 4 (d). Prize offered by Venesta, Ltd., for a Design for Interior Panel decoration of a Shoe Shop.

The awards are as follows:—

A Prize of £15 to Don J. Milne Williamson, Sheffield College of Arts and Crafts. (Nos. 2913 to 2916).

Competitors in Sub-Section 4 were set a somewhat difficult task: the use of modern plywood in furniture has introduced new constructional problems which have not yet been finally solved, but have a direct and important bearing on design. It will be convenient to consider the four competitions in this Sub-Section together. The designs sent in are, on the whole, very creditable, and it is clear that some of the competitors have carefully studied the distinctive characteristics and limitations of the material. Designs Nos. 1742, 1743 and 1744, by Philip Evans Palmer, are happily conceived and satisfying in appearance. His sections, however, are open to criticism, the hinging of the doors in particular being unpractical. George F. Bungay's designs (Nos. 995 and 996) are logical and workmanlike. His construction has been well thought out, although the elaborate

perforated panel would be expensive to cut in Plymax. The decoration on his wireless cabinet is not altogether happy, but introduces a pleasing colour interest. Some attractive drawings are submitted by Eugene Welch (Nos. 1772, 1773 and 1774). His designs are effective and appropriate, but the Judges were unable to award him a prize as the Sections revealed an unsound method of construction. The use of plywood merely as a facing to solid wood is not economical or satisfactory. Design No. 1695, by W. H. Russell, provides the most original and interesting treatment, the Plymax being used in conjunction with a steel framework. The introduction of metal into furniture construction has much to be said in its favour, and in the opinion of the Judges should be considered carefully and without prejudice. Mr. Russell's design is, unfortunately, marred by a very commonplace treatment of the handles. Of the designs sent in for the decoration of a shoe shop, No. 2913, by Donald Milne Williamson, is the one which shows most imagination.

SUB-SECTION 5. *Prizes offered by Messrs. J. and T. Scott for a set of two Designs for an Oak Combination Mantel for a Dining Room and a Mahogany Combination Mantel for a Drawing Room. The wholesale cost of each Mantel not to exceed £10.*

The awards are as follows :

A Prize of £10 to Aubrey Percival Frederick Simms, 16, Evelyn Road, Newbridge Hill, Bath. (Nos. 713 to 715).

A Prize of £5 to Frederick Charles Richter, Dromore, Dromore Road, Putney, S.W.15. (No. 510).

The cost limit of £10 included in the conditions of this competition has naturally severely limited the competitors, and the small number of designs submitted may be partly due to this factor. The prize-winning designs in the opinion of the Judges show a commendable restraint in the use of ornament, and depend upon good proportion and simple treatment.

SUB-SECTION 6. *Prize offered by the Star Manufacturing Company for a set of six Designs for Decoration of Side Panels of Baby Carriages.*

The awards are as follows : -

A First Prize of £7 10s. to Charles Henry Harnett, 114, Inverness Avenue, Westcliff, Southend-on-Sea, Essex. (No. 1124).

A Second Prize of £2 10s. to Miss Gertrude Evelyn Cook, International Correspondence Schools, Ltd. (No. 1037d).

The Judges suggest that this competitor should give more attention to the practical aspects of this kind of manufacture.

SUB-SECTION 7. *Prize offered by Messrs. William and H. H. James, Ltd., for Designs for Hat and Coat Hooks.*

Owing to the very limited number and poor quality of the designs submitted in this Sub-Section, the Judges were unable to make any award.

SECTION IV.—BOOK PRODUCTION.

SUB-SECTION 1. *A Title-page set from type with or without printers' ornaments. [The book prescribed in each Sub-Section was "The Heart of Midlothian (Demy Octavo).]*

The awards are as follows :—

A Prize of £5 5s. to David Chalmers Shand, London School of Printing and Kindred Trades. (No. 1558).

A Prize of £3 3s. to Bata Krishna Ray, London School of Printing and Kindred Trades. (No. 1716).

A Prize of £2 2s. to Ambrose Percival Pritchard, 111, Long Thornton Road, Norbury, S.W.16. (No. 1205).

Highly Commended :

Ambrose Percival Pritchard, 111, Long Thornton Road, Norbury, S.W.16. (No. 1207).

Bata Krishna Ray, London School of Printing and Kindred Trades. (No. 1717).

Peter Roberts, Hazell's Technical Institute. (No. 2115).

David Chalmers Shand, London School of Printing and Kindred Trades. (No. 1556).

Commended :

David Chalmers Shand, London School of Printing and Kindred Trades. (No. 1557).

It is to be regretted that the designs submitted in this Sub-Section do not equal the standard or number of last year.

Competitors seem to have been striving after novelty instead of considering the essentials of a title-page. Consideration should always be given to the choice and arrangement of type to obtain a dignified effect. Competitors should not submit the same designs in duplicate printed on different paper.

SUB-SECTION 2. *Three pages of text, set from type.*

The awards are as follows :—

A Prize of £3 3s. to David Chalmers Shand, London School of Printing and Kindred Trades. (No. 1561).

A Prize of £2 2s. to Bata Krishna Ray, London School of Printing and Kindred Trades. (No. 1719).

Highly Commended :

Horatio Lister, 201, Toller Lane, Bradford. (No. 2517).

William Reynolds, Heritage Arts and Crafts School. (No. 131 and No. 132).

David Chalmers Shand, London School of Printing and Kindred Trades. (No. 1560).

The designs do not reach the standard or number of those submitted last year.

The attention of competitors is drawn to the need for their designs (three pages) to be mounted on one board. The same design should not be submitted in duplicate printed on different paper.

The Judges report that there is no outstanding feature in the work submitted. Competitors seem to have been content to copy accepted styles of work.

SUB-SECTION 3. *Line drawings in black and white, suitable for reproduction by line block or wood engraving of (a) a headpiece and (b) a tailpiece.*

The awards are as follows :—

A Prize of £3 3s. each to the following :—

Miss Violet Blair Irving, Liverpool City School of Art. (No. 3534).

John Yunge-Bateman, 26, Christchurch Road, Folkestone. (No. 1802).

Highly Commended :

Miss Nora Caroline C. Ivory, Liverpool City School of Art. (No. 3536).

SUB-SECTION 4. *A Design for an illustration in black and white suitable for reproduction by line block or wood engraving.*

The awards are as follows :—

A Prize of £3 3s. each to the following :—

Miss Gladys Muriel Archer, Liverpool City School of Art. (No. 3484).

Miss Ethel Nicholson, Hornsey School of Art. (No. 2293).

A Prize of £2 2s. to each of the following :—

Miss Berenice Butler, 34, Sutherland Place, Bayswater, W.2. (No. 287).

Eric Charles Vining, Leeds College of Art. (No. 2176).

Highly Commended :

George Maurice Alcock, International Correspondence Schools, Ltd. (No. 658 and No. 659).

Miss Eileen Maria Alderson, Sheffield College of Arts and Crafts. (No. 2871)
Commended :

Miss Berenice Butler, 34, Sutherland Place, Bayswater, W.2. (No. 286).

Miss Naomi Lang, Chelsea Polytechnic School of Art. (No. 255).

The general standard of the designs submitted in Sub-Sections 3 and 4 showed a marked advance on that of last year. Not only was the design better, but in nearly every case the artist has expressed the true atmosphere of the subject with considerable success. For all-round merit the Judges are of opinion that Miss Ethel Nicholson's Design No. 2293 is worthy of special commendation for its striking technique and treatment. A strong note of originality is also shown in Miss G. M. Archer's Design No. 3484.

SUB-SECTION 5. *A case for a Binding in either cloth or leather.*

The Judges were unable to award any prize in this Sub-Section as they could find no merit or originality or feeling for design.

SUB-SECTION 6. *Designs for End-papers.*

The awards are as follows :—

A Prize of £5 5s. to Miss Bertha Julia Olyett, Press Art School. (No. 1676 and No. 1677).

Highly Commended :

Miss Audrey Isobell McLaughlin, Royal College of Art. (No. 1538).

Commended :

Miss Nancy Allen Dixon, Liverpool City School of Art. (No. 3507).

Several quite good designs and ideas were submitted as applied to the special book prescribed, but those intended for general use were too similar to existing specimens to deserve recognition.

SUB-SECTION 7. *Designs for a Jacket.*

The awards are as follows :—

A Prize of £3 3s. each to the following .—

Miss Joyce Hughlings Davies, Liverpool City School of Art. (No. 3502).

William Alfred Wright, L.C.C. Putney School of Art. (No. 1749).

Highly Commended :

Percy Drake Brookshaw, Erith Technical College. (No. 2255).

Miss Faith Geraldine L. Gaskell, Battersea Polytechnic School of Art. (No. 1634).

Commended :

Miss Elsie M. Frostick, Battersea Polytechnic School of Art. (No. 2552 and No. 2553).

Some excellent work was submitted showing considerable originality and a good conception of the subject. Several competitors weakened the look of their lettering by putting a break in the word "Midlothian."

SECTION V — POTTERY AND GLASS

SUB-SECTION 1 (POTTERY) *An original decorated design executed in Pottery Specimens to be fired, but the method of decoration which was left to the competitor, could be either over or under glaze*

The awards are as follows —

A Prize of £1 1s each to the following —

Joseph Bailey Burslem School of Art (No 2605)

Miss Freda May Beardmore Burslem School of Art (No 2615 and No 2616)



¹ Decorated designs in Pottery by C I Blackburn (Burslem School of Art), E Owen (at top), Stoke-on-Trent School of Art, and Miss F Beardmore (Burslem School of Art)

Clarence Edward Blackburn Burslem School of Art (No 2618),

Miss Ethel Norah Dawes 3, The Headlands Kettering (No 3324)

Miss Ursula Hamilton Kearne Manchester School of Art (No 3128)

Arthur Isaac Mattison, Stoke School of Art (No 3253)

Eric Owen, Stoke School of Art (No 3255)

Miss Irene Pemberton Burslem School of Art (No 2690 and No 2691)

Miss Kathleen Penney, Manchester School of Art (No 3178)

Miss Beatrice Mary Potts Burslem School of Art (No 2693)

Highly Commended —

Joseph Bailey, Burslem School of Art (No 2604)

Miss Freda May Beardmore Burslem School of Art (No 2617)

Clarence Edward Blackburn, Burslem School of Art (No 2619)

* Reproduced from *The Pottery Gazette*, September 2nd, 1929

Miss Ellen Bridgwood, Burslem School of Art. (No. 2624).
 Leonard Samuel Brookes, Burslem School of Art. (No. 2630).
 Albert Coxon, Burslem School of Art. (No. 2637).
 Cyril Stephen Lancaster, Burslem School of Art. (No. 2651).
 Miss Muriel Linton, 37, St. Margarets Road, Oxford. (No. 3326).
 Miss Emily May Mountford, Burslem School of Art. (No. 2685).
 Miss Irene Pemberton, Burslem School of Art. (No. 2692).
 Carl Rowley, Burslem School of Art. (No. 2697).

Commended :

Miss Irene Doris Barradell, L.C.C. Putney School of Art. (No. 3296).
 Clarence Edward Blackburn, Burslem School of Art. (No. 2620).
 Roy Stanley Durbar, Burslem School of Art. (No. 3356).
 Miss Eliza Goucher, Burslem School of Art. (No. 2642).
 Cyril Stephen Lancaster, Burslem School of Art. (No. 2652).
 Eric Owen, Stoke School of Art. (No. 3258 and No. 3259).
 Miss Irene Pemberton, Burslem School of Art. (No. 2688).
 Miss Beatrice Mary Potts, Burslem School of Art. (No. 2694).
 Carl Rowley, Burslem School of Art. (No. 2699).
 John Shirley, Burslem School of Art. (No. 2708 and 2709).

This year the Committee departed from their former custom of prescribing designs only by asking for finished examples in Sub-Sections (1) and (2). The response has been extremely encouraging and more than justifies the new departure. Most of the works submitted were good plastic forms, simple and suitable for their purpose. Whilst recognising the difficulty experienced by some schools in producing the finished material, the Judges think it should be possible for these to co-operate with others more suitably provided with technical equipment.

Several pieces that were otherwise successful were "chancy" in their character, and these have not met with the same approval as the others. The *ensemble* has been taken into account, and simple ceramic processes have appealed to the Judges more than elaboration.

A number of competitors obtained shapes from local manufacturers, and these works were not so satisfactory as those entirely inspired by the students. Examples of this were various covered dishes and plates of such form as to suggest the inevitable type of decoration.

The Judges felt that the uniformity of merit in the first ten competitors was so great that it was impossible to discriminate amongst them, and they decided to divide the prize of £10 10s. equally amongst them. They were particularly pleased with two specimens from Manchester.

SUB-SECTION 2. (POTTERY). *An example of Modelling in Fired Pottery. The piece to be either ornamental or useful in character, and to take the form of figures, animals, baskets of flowers, etc., or of any article of domestic use.*

The awards are as follows :—

A Prize of £5 5s. and an Owen Jones Medal to Arthur Isaac Mattison, Stoke School of Art. (No. 3254).

A Prize of £1 1s. each to the following :—

Miss Nora Youle Crossland, Sheffield College of Arts & Crafts, on account of the thoroughness in the modelling. (No. 3624).

Miss Kathleen Goodwin, 5, Kingsfield Oval, Basford, Stoke-on-Trent. (No.

3276, No. 3277 and No. 3278).

Arthur Frederick Payne, 15H, Sutton Estate, Chelsea, S.W.3. (No. 3365, No. 3366 and No. 3367).

William Ruscoe, Stoke School of Art. (No. 3265).

John Empson Tindall, L.C.C. Central School of Arts & Crafts. (No. 3280).

Very Highly Commended :

John Empson Tindall, L.C.C. Central School of Arts. (No. 3279). The Judges appreciate the ability and ambition shown by this competitor.

Highly Commended :

Eric Owen, Stoke School of Art (No. 3261).

Miss Jane Dobson Anderson Parkes, 108, West George Street, Glasgow. (No. 3292).



* Models in Fired Pottery by Miss K. Goodwin (Stoke-on-Trent School of Art).

The prize-winning work was considered by the Judges to be outstanding in the qualities expected—modelling, decorative treatment and finish. Many of the smaller pieces showed a good plastic spirit.

A large and ambitious piece (No. 2,966,) whilst being fully appreciated, was considered to be somewhat outside the scope of this Sub-Section.

SUB-SECTION 3. (POTTERY). *Design for a Plaque for wall decoration not exceeding 15in. in any dimension.*

* Reproduced from *The Pottery Gazette*, September 2nd, 1929.

The awards are as follows :—

A Prize of £1 1s. each to the following :—

Arthur Ewart Barnett, Burslem School of Art. (No. 2613).

Eric Owen, Stoke School of Art. (No. 3271).

Miss Beatrice Parton, Hanley School of Art. (No. 2726).

Highly Commended :

Arthur Isaac Mattison, Stoke School of Art. (No. 3268).

William Ruscoe, Stoke School of Art. (No. 3272, No. 3273 and No. 3274).

Miss Beatrice Anne Waldram, 3a, Downshire Hill, Hampstead, N.W.3. (No. 3289).

There was a general absence of sound design in this Sub-Section. The Judges were unable to select any outstanding work as most of the designs appeared to miss the spirit which it was desired to encourage. Many competitors failed by using unsuitable motives and hackneyed ideas. The works selected for approval were chosen because they showed either an appreciation of the modernistic tendencies or of a good traditional style. Twelve models in Pottery submitted for this Sub-Section had to be rejected as the specification distinctly mentioned " Designs only."

SUB-SECTION 4. (GLASS) *Designs for a Cocktail Glass and Shaker.*

The Judges were unable to recommend any prizes in this Sub-section, but the following award was made :—

Commended :

Leonard Green, Wordsley School of Art. (No. 2353 and No. 2355).

The exhibits in general in this Sub-Section are exceedingly disappointing, being unique in their lack of originality both in form and decoration. Not one single piece shows any enterprise at all in either outline or decorative treatment, one thing being evident—that all the competitors dash off these drawings quickly and without any thought of the object for which this competition is intended, namely, to produce some pleasing production in keeping both in style, decoration and proportion with the best artistic productions of the present day. Any one of these designs might have come out of any mid-Victorian catalogue, had they made cocktails in that era, or out of any of the many brochures that come across from the Continent. Nos 2355 and 2353 are the two better designs of the four designs submitted by Leonard Green, and these only are to be commended. It is suggested to this competitor that on another occasion four times the thought should be put into one design, and one design only submitted instead of four. The submission of many designs by one competitor rather suggests that the competitor himself either cannot make up his mind as to what is right or wrong or that he has very little confidence in the designs he produces. Design No. 2366, by R. Wilkinson is the only one which shows any departure from custom. Any of the others might conceivably be ordinary spun model Cocktail Shakers as far as their form is concerned. This competitor has decided to affix a handle, making a stoppered jug serve the purpose of a Cocktail Shaker. His reason for doing so must be either (a) for use, or (b) as a piece of ornament. As a piece of ornament it fails badly, and in use it is not only unnecessary, but inconvenient. In the first place, the handle must not be held when shaking, and, therefore, the handle makes it difficult to hold the bottle and stopper when performing this operation; moreover, ice is a necessary ingredient of the cocktail, and when shaken inside a glass vessel, gives

sufficient strain on the material without adding a glass handle to it. This is a very risky part of the vessel at the best of times, and it may be doubted whether the handle would remain intact for any period of time. Nos. 2364 (C. L. Price) and Nos. 2353 and 2356 (L. Green), are to be criticised on account of the size and capacity of their glasses; No. 2364 is hopelessly small, being hardly any larger in capacity than that of a liqueur glass. This rather suggests that these competitors have not troubled to ascertain what constitutes a Cocktail, as the holding capacity of any glass is one of its first essentials.

In general, all the designs give one the impression that all the competitors are so steeped in mitre cuts and hollows with all the stereotyped variations of the past 50 years or so that they have not applied themselves to think out any modern applications of this very old art, or even troubled to study some of the very charming applications so admirably conceived and beautifully executed in the 18th and 19th centuries.

SUB-SECTION 5. (GLASS). *Prize offered by Messrs. John Walsh Walsh, Ltd., for a design for a modern form of indirect Table or Pedestal Illumination suitable for electric light.*

The awards are as follows :—

The Prize of £10 10s. to John Empson Tindall, L.C.C. Central School of Arts & Crafts. (No. 3287).

Highly Commended :

John Empson Tindall, L.C.C. Central School of Arts & Crafts. (No. 3284, No. 3285, No. 3286 and No. 3288).

In this Sub-Section no designs, with the exception of those produced by J. E. Tindall, conform to the conditions. The remainder, with the exception of the Indian exhibits, are just Victorian cut-glass lamps. The submission of these designs supports the criticism given on the previous Sub-Section, in that the general impression given by these designs is that the competitors have not given sufficient thought to their production; otherwise, *directly* illuminated cut-glass lamps would not be submitted as designs of modern form for *indirect* table or pedestal illumination. The Indian exhibits are interesting, and it is felt that they deserve very definite encouragement. The particular designs in question fail, but not in the same way as those previously mentioned, as the Indian candidate does not appreciate the working limitations or constructional values of the material for which he is designing. Unfortunately, this is a fault over which they have very little control, and it is suggested that on another occasion, failing their ability to visit an actual glass works, they should obtain as many textbooks as are available in the public libraries on the question and, after studying them carefully, then decide as to whether they intend to treat the subject as Blown Hollow-Ware produced by hand, or as a pressed or moulded article. Having made this decision, further thought should be given to the factory production of the particular article for which they are designing, and they could then tackle the subject with some knowledge (superficial though it may be) how the article is to be produced. It must be remembered that glass is not cast and cannot be run from crucibles in the same way as any of the common or finer metals. Glass, in its working condition, is a treacherous substance which can be either gathered on the end of a hollow tube (in which case it is generally formed into a blown hollow article), or, secondly, it can be taken from the furnace on a solid rod or in a ladle (or by any of the automatic methods described in the available textbooks on glass technology), and then

placed into moulds or dies and pressed into shape, the main thing in both cases to remember is that the glass article in question has a very short working range and becomes brittle, losing its viscosity at temperatures as high as 500 to 600 degrees centigrade, and that an annealing process follows immediately on the production process. In the case of pressed glass, moulds must be kept well below the setting temperature of glass; otherwise the glass article will stick to them, and the glass article must leave the mould before it becomes too cold to be brittle; otherwise it would become chilled and would crack before it reaches the annealing process. It is therefore impossible to do any false coring or very much undercutting in the design; otherwise it would be impossible to get a hot article quickly out of the mould. These later remarks apply to some extent to J. E. Tindall's exhibits. No. 3287 is the best from the point of view of construction in design and practical utility, and presents the least difficulty to the manufacturer in making. The idea has distinct and definite merit, and although the general outline of the figures below the main column does not conform with the main block as it should do in theory, very little alteration in this respect would make this a very pleasing piece. Nos. 3284/5 conform more closely to the specification laid down in the schedule, in that they are more truly indirect lighting, but the combination of hollow pedestal with solid figures in one piece of glass is impracticable in manufacture. This applies also, though not so forcibly, to the arms and lanterns in design No. 3284. In No. 3288 the Stand and its detail do not follow out the principle laid down in its main outline. The method adopted, also, to support the figure in the centre is also very impracticable from the point of view of utility. No. 3286 is pleasant and of good composition, but lacking in originality in comparison with Nos. 3284/5, and in constructional strength with the winning design. Nevertheless, it is quite a pleasant subject well treated and with restraint, giving the impression that the artist is working well within his limits. The Judges would suggest that the base of this piece should be re-designed, having regard to the fact that the base has to stand firmly and should give the impression of solidity; it is very doubtful whether this would be the case when the necessary lighting fittings had been inserted in this design. J. E. Tindall's designs are the only ones in this Section which merit an award, but had he confined himself to one or two designs at the outside, and supplemented them with the working drawings of how the moulds in question were to be made, his designs would have carried far greater weight, and many of their small defects would have presented themselves to the designer before the drawings were submitted.

SECTION VI.—ADVERTISING

POSTERS.

SUB-SECTION 1. Prize offered by the Blackpool Corporation Advertising Committee for a Design for a Poster to advertise Blackpool as a Seaside Resort.

The Judges were unable to recommend that the full prize of £25 should be given, but the following awards were made:—

A First Prize of £15 to Sidney Vincent Dimond, Camberwell School of Arts and Crafts. (No. 2012).

A Second Prize of £10 to Arthur Leslie Butler, 25, Sutherland Place, Bayswater, W.2. (No. 373).

Commended:

John Dixon, Bradford College of Art. (No. 2513).

John Pinkney Gowland, 137, Boundary Road, Woking, Surrey. (No. 2934).

Thomas Hancock, 507, North Road, Darlington. (No. 70).

Miss Mary Jocelyn Hughes, St. Martin's School of Art. (No. 1655).

None of the designs seemed to be sufficiently outstanding to warrant the award of the whole prize of £25, but the two prize-winning designs have real merit. The design of S. V. Dimond (No. 2012) shows originality, while the design of A. L. Butler (No. 373) is well executed. The design of Cecil Cooke (No. 671), while not quite effective as a poster, would make a good newspaper cartoon.

SUB-SECTION 2. Prize offered by the British Poster Advertising Association for a Design for a Poster to advertise the advantages of Poster Publicity.

The awards are as follows:—

The Prize of £50 was awarded to William Hobson, 29, Farm Hill Square, Meanwood, Leeds. (No. 80).

Highly Commended:

Sydney Durant Banks, Northampton School of Arts and Crafts. (No. 239).

Arthur Leslie Butler, 25, Sutherland Place, Bayswater, W.2. (No. 374).

Wilfred Walker, 17, Walker Street, York. (No. 591).

William Bisset Wyllie, 131, Blenheim Place, Aberdeen. (No. 582).

Commended:

Leonard Grosvenor Stanley, The Bungalow, Gorway Road, Walsall. (No. 2499).

The designs submitted in this Sub-Section numbered 89, and in the opinion of the Judges the general standard was quite good. The prize-winning design "told the story" with force and simplicity. A. L. Butler's design (No. 374) is a striking and effective sketch, but one that would probably lose a great deal when enlarged to 16-sheet size. W. Walker's design (No. 591) is strong in conception and well carried out, but would have been improved by better lettering. S. D. Bank's design (No. 239) shows an effective modern treatment, but would be more suitable as a showcard. Many of the designs submitted "missed the point" and would have served equally well as advertisements for cocoa or custard powder; others, whilst good as showcards, were quite unsuitable for use as posters. Many designs were spoilt by (a) indifferent lettering and (b) too much lettering. Competitors should remember that a poster must tell its story at a glance and that the phrase or slogan should be as brief as possible.

SUB-SECTION 3. Prize offered by the British Commercial Gas Association for a Design for a Poster advertising Gas.

The Judges, while recognising that the problem of representing gas as a source of light, heat and power is a difficult one, did not feel that any of the designs submitted was worthy of the award of the full prize of 50 guineas. They recommended, however, that the following awards be made:—

A Prize of £10 10s. each to the following:—

Miss Rosamond Curtis, Slade School of Art. (No. 216).

Robert Woodnorth, 21, Duke Street, Whitehaven. (No. 1283).

Commended:

Stanley Henry Burman, Willesden Polytechnic Art School. (No. 998).

David Macdonald Cameron, British and Dominions School of Drawing, Ltd. (No. 16).

Frederick James Joseph Dean, East Ham Technical College. (No. 1620).

Harold Hemingway, Rochdale School of Art. (No. 2829).

Walter Pritchard, Dundee School of Art. (No. 1980).

Hector Alexander Stewart, Homestead, Bearsden, Glasgow. (No. 1562).

SUB-SECTION 4. Prize offered by Messrs. Henley's Tyre and Rubber Co., Ltd., for a Design for a Poster advertising the Company's Golf Balls.

The Judges were unable to recommend that the full prize of £50 should be given, but the following awards were made :—

A Prize of £10 10s. to Alfred Edward Sergeant, Leyton School of Art. (No. 951).

A Prize of £5 5s. to John Joseph Nesbit, 37, London Road, Leicester. (No. 1197).

Highly Commended :

Ernest Morley Blatchford, Bournemouth School of Art. (No. 2731).

Commended :

Charles Dean, Liverpool City School of Art. (No. 3504).

John Pinkney Gowland, 137, Boundary Road, Woking, Surrey. (No. 2936).

Elcon Hirsch, Regent Street Polytechnic School of Art. (No. 3619).

While they recognise that the subject is a difficult one to handle, the Judges regret that the designs in general show little initiative or recognition of the essentials required in advertising—simplicity and directness. Students should be encouraged to study the requirements of the firms for whom they are designing. In this competition few competitors have appreciated the "selling points" of a golf ball.

Designs Nos. 951 and 1197 are, however, meritorious and have been awarded prizes.

SUB-SECTION 5. Prize offered by Messrs. Hugon and Co., Ltd., for a Design for a Poster advertising "Atona" Shredded Beef Suet.

The Judges were unable to recommend that the full Prize of £50 should be given, but the following awards were made :—

A First Prize of £25 to Thomas John Fry, 34, Egham Road, Plaistow, E 13. (No. 1389).

A Second Prize of £10 to Harold Thornton, Burnley School of Arts and Crafts. (No. 959).

The general standard of the designs was poor. Many of them were conceived in terms of booklet covers rather than posters. H. Thornton's design (No. 959) showed a high standard of lettering and good balance. Several designs omitted the fact that Atona is *beef suet*, which is the most important selling point in the whole campaign.

SUB-SECTION 6. Prize offered by Motorways, Ltd., for a Design for a Poster describing their Motor Pullman Tours.

The Judges were unable to recommend that the Prize of 25 guineas should be given, but the following awards were made :—

Commended :

Philip Hepworth, Leeds College of Art. (No. 2164).

Oswald Stanhope, Black and White Studios, Bedford Street, W.C.2. (No. 947).

Cyril Francis Webber, Goldsmiths' College School of Art. (No. 962).

The general standard of this Sub-Section was low and showed a great lack of originality of thought.

No design was thought worth the expense of reproduction. One was a flagrant example of plagiarism from the Chrysler advertising.

The general design, lay-out, and lettering were poor; nor had economy of reproduction been studied, with one exception, and in this case the student forgot entirely that he was advertising a Motor Coach Service.

Three designs were commended because there was some pretension to technical skill and also on account of their "sunny atmosphere."

SUB-SECTION 7. *Prizes offered by the Orient Line for a Design for a Poster advertising the Orient Line Mail Steamers to Australia.*

The awards are as follows :—

The First Prize of £30 to Percival Albert Trompf, 501, Little Collins Street, Melbourne, C.I., Victoria, Australia. (No. 2000).

The Second Prize of £10 to Basil White Ridley, Talboys, Broadham Green, Oxted, Surrey. (No. 1862).

Highly Commended :

Miss Winifred Amy Pringle Forgan, L.C.C. Central School of Arts and Crafts. (No. 340).

Arthur Edward Morrison, Liverpool City School of Art. (No. 3544).

Alfred Gordon Randall, 12, Manor Way, Uxbridge, Middlesex. (No. 1265).

Clifford Rumney, 41, Burghley Road, St. Andrew's Park, Bristol. (No. 704).

George F. Yarnell, 450, Upper Richmond Road, Richmond, Surrey. (No. 1313).

Commended :

Frederick Brian Hayes, Bath School of Art. (No. 1419).

Arthur Edward Morrison, Liverpool City School of Art. (No. 3545).

The entries are very encouraging, both in number and quality. They depend more upon their subject matter and their design than upon slogans. Strangely few are based upon catchwords, although one or two bills, such as No. 704 (C. Rumney) and No. 3515 (E. Fancott) are commendable in this way. Several attractive designs demand an expensive number of printings to attain their proper colour effect and this should perhaps have been more clearly borne in mind by the designers.

Perhaps the commonest failing of all has been the inability to eliminate detail. As a result lettering is often swamped by superfluous abstractions and promising colours drowned by others.

Several bills of the pure design type are successful and others depending upon simple lettering and colour are also pleasing, *e.g.*, No. 3545 (A. E. Morrison).

An interesting sidelight on the competition was the apparent difficulty of adapting the kangaroo to decorative purpose, or, indeed, of drawing it at all.

Several bills were rejected as they contained no lettering, and the Judges did not consider they could fairly compete with bills designed as a complete poster, with appropriate lettering.

In awarding the First Prize, the Judges felt that a vivid impression without too lavish a colour scheme, but telling its story in a very direct way, holds its own among more extravagant competitors. The second place was allotted to a symmetrical design using the ship as a focus of interest without any attempt at photographic representation. Both of these in entirely different ways, the Judges considered extremely effective. Their eventual choice was only made after prolonged consideration.

SUB-SECTION 8. *Prize offered by the Prudential Assurance Company, Ltd., for a Design for a Poster advertising Insurance in general, and that Company in particular.*

The Judges were unable to recommend that the full prize of 25 guineas should be given, but the following awards were made :—

A Prize of £5 5s. to John James Heath, Keighley School of Art and Crafts. (No. 2147).

Commended :

William Blamire, 35, Eskdail Street, Kettering. (No. 199).

Arthur Jack Cooper, 64, Grove Avenue, Twickenham. (No. 1582).

SUB-SECTION 9. *Prizes offered by Messrs. Simpson and Godlee, Ltd., for a Design for a Poster advertising "Essangee Unfading Prints."*

The awards are as follows :—

The First Prize of Thirty Guineas and an Owen Jones Medal to Miss Christina Forsyth, Edinburgh College of Art. (No. 3422).

The Second Prize of Twenty Guineas to Miss Adeline Mary Constance Hone, Leeds College of Art. (No. 2166).

Highly Commended :

Miss Margaret Marion Ransford Cawood, Arden, Cornwall Road, Harrogate. (No. 434).

Miss Phyllis Gordon Dunlop, Leeds College of Art. (No. 2157).

Harold Hemingway, Rochdale School of Art. (No. 2824).

Commended :

Miss Faith Geraldine Leycester Gaskell, Battersea Polytechnic School of Art. (No. 1628).

Miss Joan Horton, 20, South Hill Park Gardens, N.W.3. (No. 1909).

Miss Marie Kale, Rochdale School of Art. (No. 2845).

Miss Stella Frances Ogle, Leeds College of Art. (No. 2171).

William Bisset Wyllie, 131, Blenheim Place, Aberdeen. (No. 587).

On the whole there appeared to be too much tendency to play down to the intellect of the commercial man, and too much plagiarism.

In these days of improved advertising it was remarkable that there was so much bad lay-out and bad lettering. There was, however, a big gap between the mass of the work submitted and a small group of excellent designs, which were technically good and quite fit for their purpose.

SHOWCARDS.

SUB-SECTION 10. *Prize offered by Messrs. Carreras, Ltd., for a Design for a Cut-out Showcard suitable for their Turf Cigarettes.*

The Judges were unable to recommend that the full Prize of 25 guineas should be given, but the following awards were made :—

A Prize of £5 5s. to John Fitzgerald Lawrie, Bournemouth School of Art. (No. 2739).

Commended :

George Archibald Frank Austen, Dover School of Art. (No. 3338).

SUB-SECTION 11. *Prizes offered by Messrs. J. S. Fry and Sons, Ltd., for Designs for Showcards advertising (a) Fry's Caramels, (b) Fry's Cream Tablets.*

(a) The awards were as follows :—

The First Prize of £15 15s. to George Frederick Lunt, Liverpool City School of Art. (No. 3542).

The Second Prize of £7 7s. to Leonard Towers, Liverpool City School of Art. (No. 3580).

Commended :

Miss Margaret Eleanor Hinckley, Nottingham School of Art. (No. 3003).

Roy McLachlan, Rochdale School of Art. (No. 692).

(b) The awards were as follows :—

The First Prize of £15 15s. to Harry Turner, Halifax School of Art. (No. 2598).

The Second Prize of £7 7s. to Edmund William Green, Croydon School of Art. (No. 879).

Commended :

Miss Lily Evelyn Garrard, Ipswich School of Art. (No. 2134).

The entries as a whole are disappointing. Many of the competitors fail to realise that a strong and attractive design is far more important than a punning caption. When the endeavour is to make a pictorial joke the designs are liable to become mere illustrations. The most successful showcards are those in which a bright and decorative arrangement has been made out of the tablets or the "cartets" themselves. It should be remembered that simplicity and clarity has great value in a crowded sweet shop window. George F. Lunt achieved a very pleasant and bright design by very simple means in No. 3542, while No. 2598 (H. Turner), although rather thin in colour, has been awarded the first prize in (b) because of its simplicity and its good use of white space.

SUB-SECTION 12. *Prize offered by Messrs. W. T. Henley's Telegraph Works Co., Ltd., for a Design to advertise the Henley Wiring System.*

The Judges were unable to recommend that the full Prize of £25 should be given, but the following awards were made :—

A Prize of £10 to Roderick Melrose Clark, Liverpool City School of Art. (No. 3497).

Commended :

William Blamire, 35, Eskdaill Street, Kettering. (No. 201).

Roderick Melrose Clark, Liverpool City School of Art. (No. 3498).

Peter Thomas Alfred Roberson, City of Oxford School of Arts and Crafts. (No. 2307).

Leonard Towers, Liverpool City School of Art (No. 3581).

None of the designs submitted for competition are considered suitable for the purpose. No. 3497 (R. M. Clark) comes nearest to the required standard. This design, together with No. 3581 (L. Towers), No. 2307 (P. T. A. Roberson), No. 3498 (R. M. Clark) and No. 201 (W. Blamire), show a good standard of draughtsmanship.

SUB-SECTION 13. *Prizes offered by Messrs. Rowntree and Co., Ltd., for a Design for a Cut-out Showcard to advertise their "Tried Favourites."*

The Judges were unable to recommend that the full amount of prizes should be given, but the following awards were made :—

A First Prize of £10 to Stanley Richard Simms, 33, Victoria Road, Kentish Town, N.W.1. (No. 527)

A Second Prize of £5 to Norman Francais John Abrahams, Blackheath School of Art and Crafts (No. 1356).

Commended :

Benjamin Ward Lawton, Nottingham School of Art. (No. 3008).

Harold Kenneth White, Blackheath School of Art and Crafts. (No. 1797).

Whilst the designs this year show greater thought than in previous years, sufficient attention has not been given to arrangement of colour schemes; more regard might also have been paid to suggestions contained in the firm's current advertising. A number of the designs submitted have quite a spotty appearance, which is detrimental to good display. The Judges regret that the designs do not warrant the award of the full prize amounts offered, and have decided as above.

COVERS AND PRESS ADVERTISEMENTS.

SUB-SECTION 14. *Prize offered by the Brighton Corporation Publicity Committee for a Design suitable for the Cover of the Brighton Official Guide.*

The awards are as follows :—

The Prize of £10 to Arthur Leslie Butler, 25, Sutherland Place, Bayswater, W.2. (No. 376).

Commended :

Miss Helen K. Willows, Manchester School of Art. (No. 3245).

The Judges have awarded the prize to A. L. Butler's design (No. 376), as showing the requirements of the Brighton Corporation Publicity Committee more than any of the other designs. It depicts a view of Brighton in the background, suggests sunshine and a good class of visitors—three important points for this type of advertisement. Miss H. K. Willows' design (No. 3245) is commended for its artistic qualities.

COVERS AND PRESS ADVERTISEMENTS.

SUB-SECTION 15. *Prizes offered by Messrs. Hodder and Stoughton for (a) a Design for a Catalogue Cover suitable for their Fiction List, and (b) a Design suitable for their Belles Lettres and Religious Works List.*

(a) The awards are as follows :

The Prize of £10 10s. to Miss Margaret Doreen Browning, Belswains, New Dover Road, Canterbury, Kent (No. 859).

Commended :

Miss Kathleen Mary Lawrence, Croydon School of Art. (No. 2065)

(b) The Judges were unable to recommend that the Prize of £10 10s. should be given, but the following awards were made

Highly Commended :

Miss Katie McDonald, I. C. C. Central School of Arts and Crafts. (No. 1838).

William Carter Wade, Halifax School of Art (No. 2603).

Commended :

Miss Daphne Victoria Barry, Battersea Polytechnic School of Art. (No. 2533).

The standard of work being of but a poor character, the Judges were only able to give the full award in the Fiction List Sub-Section. A number of the designs made no attempt to conform to the conditions laid down.

SUB-SECTION 16. *Prize offered by Messrs. Hovis, Ltd., for a Design suitable for an Advertisement of Hovis Bread in the Press or for a small Poster or Showcard.*

The Judges were unable to recommend that the full Prize of £50 should be given, but the following awards were made :

A Prize of £10 10s. each to the following

Frederic Gradwell, 15, Blake Street, Bolton. (No. 679)

Peter Robertson, 1, Fernley Road, Mile End, Stockport. (No. 938).

William Lewis Winney, Leyton School of Arts and Crafts. (No. 1769).

In view of the amount of the prize offered the general standard of the work submitted was disappointing. In making the awards the Judges kept in mind the provisions laid by the donors, namely :

(a) A Loaf of Hovis Bread should appear in the design

(b) A strong home appeal should be made.

Of the prize-winning designs, No. 938 by Peter, Robertson conforms best with these conditions. No. 679, by Frederic Gradwell, as an advertisement in an illustrated paper, is infinitely superior in execution and draughtsmanship, but does not meet to the same extent the requirements of the above-mentioned conditions.

The same remarks apply to W. L. Winney's design (No. 1769), in which the domestic appeal is not sufficiently emphasised.

SUB-SECTION 17. *Prize offered by Messrs. John Player and Sons for a Design for a Black and White Advertisement of Player's Navy Cut Cigarettes suitable for reproduction in the Press.*

The Judges were unable to recommend that the full Prize of £50 should be given, but the following awards were made :—

A First Prize of £10 10s. to Edward Bishop, L.C.C. Central School of Arts and Crafts. (No. 292 and No. 293).

A Second Prize of £5 5s. to Claude Gilliard, Clifton Arts Club. (No. 680, No. 681 and No. 682).

A Prize of £2 2s. to Thomas Molyneux Paul, 404, Finchley Road, N.W.2. (No. 1678).

Highly Commended :

James Reddoch, Liverpool City School of Art. (No. 3564).

Christopher Cavana Sanders, Royal College of Art. (No. 1933).

Commended :

George Francis Bungay, 16, Hardenwaye, Totteridge, High Wycombe, Bucks (No. 997).

Versatility was shown in the designs submitted in this Sub-Section, but having regard to the value of the prize offered, the general standard was not considered high enough to warrant the full award.

Many of the competitors did not take sufficient care to give effect to the main requirement of this competition, which was that the advertisement should be suitable for Press advertising. Some designs, although otherwise quite effective in treatment, were open to objection from the point of view of suitability to the product.

The Judges decided to award consolation prizes where particular merit was shown. The award in respect of the designs Nos. 680-682, by Claude Gilliard, was made for originality of treatment.

An admirable advertising idea, although not suitable for Messrs. John Player and Sons' purpose, was contained in T. M. Paul's design (No. 1678.)

LORRY BILL.

SUB-SECTION 18. *Prize offered by Shell-Mex, Ltd., for a Design for a Lorry Bill advertising Shell Lubricating Oil or Shell Petrol, or both.*

The awards are as follows :—

A Prize of £13 2s. 6d. each to the following :—

Kenneth Beeley, Sheffield College of Arts and Crafts. (No. 2875).

William Bisset Wyllie, 131, Blenheim Place, Aberdeen. (No. 588).

Commended :

James Browning, Battersea Polytechnic School of Art. (No. 2537).

Frederick James Joseph Dean, East Ham Technical College. (No. 1606).

Ralph Ramm, L.C.C. Central School of Arts and Crafts. (No. 1866).

The Judges were disappointed with the general level of attainment as to 75 per cent. of the designs submitted. They were of opinion that there was insufficient originality of thought and too great a tendency to be influenced by the success of others.

Of the two prize-winning designs, No. 588, by W. B. Wyllie, appealed to all the Judges as having the most intrinsic interest, but the artist has exceeded the number of colours laid down and has used lettering which both detracted from the design and was difficult to read. No. 2875, by K. Beeley, showed considerable originality

and sound drawing, but was to some extent spoilt by an unnecessary slogan and the fact that the ducks appeared to be finishing their flight rather than starting it

CALENDARS AND CHRISTMAS CARDS

SUB-SECTION 19 *Prizes offered by Messrs C W Faulkner and Co., Ltd for (a) a Design for a Calendar and (b) a Design for a Christmas Card*

(a) The Judges were unable to recommend that the full amount of prizes should be given, but the following awards were made

A Prize of £10 to Miss Joan Hoyle, 86, Oakfield Road Cannon Hill, Birmingham (No 1136)

A Prize of £5 to Miss Marian Fielding Peck Sheffield College of Arts and Crafts (No 2898)

Commended

Miss Adeline Mary Constance Hone Leeds College of Art (No 2165)

John Bowyer Oakley, Heatherley School of Art (No 1200)

(b) The Judges were unable to recommend that the full amount of Prizes should be given, but the following awards were made

A Prize of £7 10s to Miss Winifred Jane Pearcey Keighley School of Art and Crafts (No 503)

A Prize of £5 to Miss Gwendoline Dolman Sheffield College of Arts and Crafts (No 2919)

A Prize of £4 to Miss Florence Walker Harrogate School of Art (No 608)

Commended

Miss Mary Mack Cornwall, Canada (No 111)

Miss Wendy Joyce Morel, Bickham Manor, Timberscombe, Launton (No 693)

A large proportion of the designs submitted both under (a) and (b) showed too little consideration of the question of suitability for the purpose, nor was much originality displayed in this Sub-Section

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

MONDAY NOVEMBER 1 Automobile Engineers Institution of at the Merchant Venturers Technical College, Bristol 6.45 p.m. Captain I. W. Johnson The Inspection of Metals and their Alloys
Electrical Engineers, Institution of Savoy Place W.C. 7 p.m. Discussion on 'Paris and the Pyrenies Notes on some of the Technical Features of the I.F.F. 1926 Visit' Opened by Mr. R. Borlase Matthews
At the University, Liverpool 7 p.m. Messrs. Johnstone Wright and C. W. Marshall The Construction of the Grid Transmission System in Great Britain
Engineers, Society of, at Burlington House W.C. 6 p.m. Mr. Gerald A. Wright, 'Land Drainage'
Farmers' Club, at the Whitehall Rooms Hotel Metropoli, Whitehall Place, S.W. 4 p.m. Prof. W. G. S. Adams 'The Progress and Work of Rural Community Councils'
Geographical Society, at the Aeolian Hall, New Bond Street, W. 8.30 p.m. Mr. H. G. Watkins, 'River Exploration in Labrador by Canoe and Dog Sledge'
Royal Institution, Albemarle Street, W. 5 p.m. General Meeting
University of London, at Bedford College, Regent's

Park N.W. 5.30 p.m. Prof. P. Hazard Le Voyage et la Mentalité Française au XVIII^e Siècle (Lecture II)
At Kings College Strand W.C. 5.30 p.m. Rev. G. J. Newson The Church and the World Lecture V. The Passing of Medicinalism
At Kings College Strand W.C. 5.30 p.m. Rev. C. J. Rogers Ecclesiastical Music Lecture I - A Parish Concert
At University College Gower Street W.C. 5 p.m. Prof. I. N. G. Hion England in Shakespeare's Day Lecture IV. Constantinople in the 16th Century
At University College Gower Street W.C. 5 p.m. Dr. R. J. Brookehurst Secretion of the Digestive Juices (Lecture IV)
At University College Gower Street, W.C. 5 p.m. Sir C. V. Raman Molecular Scattering of Light Lecture I The Classical Theories and their Experimental Test
At University College Gower Street W.C. 5.30 p.m. Prof. J. F. Neal The Elizabethan Parliament (Lecture IV)

TUESDAY NOVEMBER 5 Arts Academy of, Burlington House W. 4.30 p.m. Prof. Arthur Thomson, F.R.C.S. 'Anatomy - A Rapid Survey of the Main Features of the Upper Limb'
Automobile Engineers, Institution of at the Royal Society of Arts, Adelphi, W.C. 7.45 p.m. Dr. W. H.

Hatfield, "Automobile Steels." (Joint Meeting with the Iron and Steel Institute).
Civil Engineers, Institution of, Great George Street, S.W. 6 p.m. Mr. W. W. Grierson, Presidential Address.

Empire Society, at the Hotel Victoria, Northumberland Avenue, W.C. 8.30 p.m. The Right Hon Sir Hilton Young, "The East African Opportunity."

Television Society, at the Engineers' Club, Coventry Street, W. 8 p.m. Mr. F. Langford-Smith, "Amplification and Television."

University of London, at Bedford College, Regent's Park, N.W. 5.30 p.m. Prof. P. Hazard, "Le Voyage et la Mentalité Française au XVIII^e Siècle." (Lecture II).

At King's College, Strand, W.C. 5 p.m. Dr. J. W. Pickering, "Blood Plasma and Platelets." (Lecture V).

At King's College, Strand, W.C. 5.30 p.m. Mrs. N. A. Duddington, "Russian Philosophy at the Present Time."

At King's College, Strand, W.C. 5.30 p.m. Prof. Sir B. Pares, "Russian History to 1861. Lecture IV—Western Neighbours: Norway."

King's College, 140 Tottenham Square, N.E. 5.30 p.m. Dr. J. Krzyzanowski, "The Polish Novel in the 19th Century. Lecture III—Boleslas Prus and the Social Novel."

At the London School of Economics, Houghton Street, W.C. 5 p.m. Dr. M. Ginsberg, "The Contribution of Prof. Hobhouse to Philosophy and Sociology."

At University College, Gower Street, W.C. 5 p.m. Sir C. V. Raman, "Molecular Scattering of Light. Lecture II.—New Paths in Molecular Optics."

Zoological Society, Regents Park, N.W. 5.30 p.m. Scientific Business Meeting.

WEDNESDAY, NOVEMBER 6. Analysts, Society of Public, at Burlington House, W. 8 p.m. (1) Messrs. E. R. Bolton and K. A. Williams, "The Grouping of Fatty Oils, with Special Reference to Olive Oil." (2) Dr. Cuthbert Dukes, "The Heat Resistance Curve. A New Bacteriological Test for Pasteurised Food." (3) Messrs. W. R. Mummery and F. Bishop, "A New Borax Solubility Test for Lactic Acid or Natural Sour Casein."

Electrical Engineers, Institution of, Savoy Place, W.C. 6 p.m. Captain C. E. Kennedy-Furvia, R.N. (Chairman of the Wireless Section), Inaugural Address.

Geological Society, Burlington House, W. 5.30 p.m. (1) Dr. H. Bolton, "Fossil Insects of the South Wales Coalfield." (2) Major A. R. Dwyerhouse, D.Sc., and Mr. A. A. Miller, "The Glaciation of Clun Forest, Radnor Forest, and some Adjoining Districts."

Heating and Ventilating Engineers, Institution of, at 29 Hart Street, Bloomsbury, W.C. 7 p.m. Mr. R. Grierson, "Notes on Electric Warming, with special reference to Low Temperature Panel Systems."

North East Coast Institution of Engineers and Shipbuilders, at Balbec Hall, Newcastle-upon-Tyne, 7.15 p.m. Address by Mr. H. A. Morham, Chairman of Graduate's Section.

Public Health, Royal Institute of, 37 Russell Square, W.C. 4 p.m. Dr. Stanford Cade, "The Possibilities and Limitations of Radium Treatment."

University of London, at Bedford College, Regent's Park, N.W. 5.30 p.m. Prof. P. Hazard, "Le Voyage et la Mentalité Française au XVIII^e Siècle." (Lecture III).

At King's College, Strand, W.C. 5.30 p.m. Dr. F. A. P. Aveling, "Personalism: A Psychological Approach to Reality. Lecture V.—The Approach to Transcendental Reality."

At King's College, Strand, W.C. 5.30 p.m. Prof. D. M. Blair, "The Contribution of King's College to the Advancement of Learning during the Century 1829-1928. Lecture V—Medical Science."

At the London School of Economics, Houghton Street, W.C. 6 p.m. Lecture V on "Office Machinery."

At University College, Gower Street, W.C. 3 p.m. Dr. C. Pellizzi, "La Lirica del Paradiso." (Lecture I).

At University College, Gower Street, W.C. 5.30 p.m. Mr. I. C. Grønhaug, "Some Norwegian Writers of the Present Day (Risnaal)." (Lecture I).

At the Royal Veterinary College, Great College Street, N.W. 5.30 p.m. Major G. W. Dunkin, "Recent Researches on Immunization against Distemper in the Dog." (Lecture I).

THURSDAY, NOVEMBER 7. Aeronautical Society, at the Royal Society of Arts, Adelphi, W.C. 6.30 p.m. Dr. A. E. Dunstan, "Recent Developments of Fuel and Dopes for Aircraft Engines."

Chemical Society, Burlington House, W. 8 p.m. (1) Messrs. F. Challenger, C. Higginbottom and A. Huntington, "The Nitration of Aromatic Thiocyanates." (2) Messrs. F. Challenger and A. D. Ainley, "Studies of the Boron-carbon Linkage. Part I. The Oxidation and Nitration of Phenylboric Acid."

Electrical Engineers, Institution of, Savoy Place, W.C. 6 p.m. Messrs. B. A. G. Churcher and A. J. King, "The Analysis and Measurement of the Noise emitted by Machinery."

Electrical Association for Women, at Messrs. Shoobred, Ltd., Tottenham Court Road, W. Mr. W. J. Jones, "Electric Light and Eye-Sight Preservation."

Linnean Society, Burlington House, W. 5 p.m. L.C.C., The Geoffrey Museum, Kingsland Road, E. 7.30 p.m. Sir Charles Allom, "The Restoration of an Ancient Castle to Modern Use."

University of London, at Bedford College for Women, Regent's Park, N.W. 4.30 p.m. Prof. Feeles, "Montaigne" (in French). Lecture V.

At King's College, Strand, W.C. 3 p.m. Mr. C. I. Gadd, "The Babylonian Background of the Captivity." At King's College, Strand, W.C. 5 p.m. Dr. J. A. Hewitt, "Metabolism of the Carbohydrates and Fats" (Lecture IV).

At King's College, Strand, W.C. 5.30 p.m. Mr. H. W. Steed, "The Minorities Question and the Union of Europe. Lecture IV—A United States of Europe."

At the London School of Economics, Houghton Street, W.C. 5 p.m. Prof. L. Robbins, "The Present Position of Economic Science."

At University College, Gower Street, W.C. 5 p.m. Sir C. V. Raman, "Molecular Scattering of Light. Lecture III.—Light Scattering and the Quantum Theory."

At University College, Gower Street, W.C. 5.30 p.m. Rt. Hon. Viscount Grey of Fallodon, "Natural History, the Pleasure and Purpose of Observation."

At the Victoria and Albert Museum, South Kensington, S.W. 5.30 p.m. Sir L. Weaver, "English Lead Work."

FRIDAY, NOVEMBER 8. Astronomical Society, Burlington House, W. 5 p.m.

Asiatic Society, at Burlington House, W. 5 p.m. Sir Aurel Kohn, "Alexanders' Campaigns on the North West Frontier of India." (Joint Meeting with the Central Asian Society.)

Illuminating Engineering Society, at the Royal Society of Arts, Adelphi, W.C. 6.30 p.m. Mr. W. S. Stiles, "The Nature and Effects of Glare."

Junior Institution of Engineers, 30 Victoria Street, S.W. 7.30 p.m. Annual General Meeting.

Malacological Society, at University College, Gower Street, W.C. 6 p.m.

Metals, Institute of, at the University, Sharnfield 7.30 p.m. Mr. F. Orme, "Nickel-Silver."

Oil and Colour Chemists' Association, at Liverpool, 7 p.m. Dr. Fox, O.B.E., "Some Reminiscences of a Government Laboratory."

Physical Society, at the Imperial College of Science and Technology, Imperial Institute Road, S.W. 5 p.m. Prof. Sir C. V. Raman, F.R.S. "Diamagnetism and Molecular Structure."

University of London, at King's College, Strand, W.C. 5.30 p.m. Monsieur Benjamin Crémieux, "The French Novel. Lecture III—Balzac."

At King's College, Strand, W.C. 5.30 p.m. Prince D. S. Minsky, "The Russian Drama. Lecture IV—Ostrovsky."

At King's College for Household and Social Science or Campden Hill Road, W. 5 p.m. Prof. W. H. Mottram, "Human Nutrition." (Lecture IV).

At University College, Gower Street, W.C. 5.30 p.m. Mr. C. S. Elton, "The Future of Animal Ecology." (Lecture III).

At University College, Gower Street, W.C. 5.30 p.m. Sir Richard Lodge, "English Parties and Foreign Policy in the Eighteenth Century." (Lecture II).

SATURDAY, NOVEMBER 9. L.C.C. The Horniman Museum, Forest Hill, S.E. 3.30 p.m. Mr. John E. S. Dallas, "Wild Flowers in London's Open Spaces."

JOURNAL OF THE ROYAL SOCIETY OF ARTS

No. 4016.

VOL. LXXVII.

FRIDAY, NOVEMBER 8th, 1929.

*All communications for the Society should be addressed to the Secretary John Street,
Adelphi, W C (2)*

NOTICES.

NEXT WEEK.

WEDNESDAY, NOVEMBER 13th, at 8 p.m. (Ordinary Meeting). J. O. BOVING, "New Developments in Hydraulic Pneumatic Engineering." CHARLES VERNON BOYS, F.R.S., will preside.

REPRINTS OF CANTOR AND SHAW LECTURES.

The three Cantor Lectures on "The Treatment of Coal," by Dr. C. H. Landel, C.B.E., M.Inst.C.E., M.I.Mech.E., and the three Shaw lectures on "Thirty Years' Experience of Industrial Maladies," by Sir Thomas Morison Legge, C.B.E., M.D., have been reprinted in pamphlet form (price 2s. 6d. each), and can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, W.C.2.

A complete list of Cantor, Howard and other lectures, which are available in pamphlet form, can be had on application

PRESERVATION OF ANCIENT COTTAGES.

WEST WYCOMBE

The *Journal* of March 22nd announced that the Council had agreed to purchase the Village of West Wycombe, Buckinghamshire, and since then a good deal has appeared in the public press in connection with this important transaction by the Society. Although there is no evidence yet of any restoration work, a great deal of preparatory work has been done, and it is hoped that in the New Year the Village will begin to take on an entirely new aspect. The Society realise their responsibility in undertaking this work, and have not yet



made any definite appeal to the County for financial assistance, as they felt it better to do this when they were in a position to start the work of restoration. They have, however, received a number of generous contributions to the fund, and they are very hopeful that the necessary amount to complete the purchase will be forthcoming when the booklet descriptive of their aims is issued. Her Majesty the Queen has shown her interest in the preservation of this Village by accepting an advance copy of the Appeal booklet and giving Her consent to this being formally announced. The American Ambassador has also accepted a copy and expressed his pleasure that there was an organised movement by the Society for protecting the engaging beauty of England. As he says, the preservation of West Wycombe saves for the future a fine picture of English life and history. The Haig Trust for Disabled Ex-Service Men has entered into a contract to take over the rather derelict block of cottages on the left as you enter the village, to spend a considerable sum in remodelling these from within, and to build behind such additional cottages as they require for a little community group. No alteration will be made to the external appearance of the cottages without the consent of the Society's advisers. This work would have been started by now but the Haig Trustees stipulated that they could not sign the contract without a definite undertaking that proper drainage facilities would be provided by the authorities. The Rural Council are negotiating with the Urban Council with this end in view, and it is hoped very shortly to be in a position to begin the work. The hotel and the two inns have two years to run before they come into the possession of the Society, but the Society's Agent is dealing with the question of dilapidations, and it is hoped soon to report when these will be reconditioned and made wholesome places for refreshment. There was one interesting house in the village which the Society were not able to acquire in the first instance, as Sir John Dashwood needed it for his Agent. As he is now able to provide accommodation elsewhere on his Estate, it was thought desirable to acquire this. The Society felt it needed some official centre in the village where information could be given as to its activities, and which might be a kind of guest-house. Through the generosity of Lady Binning, who has already been a liberal friend of the movement, this house has now been acquired and will be restored and made suitable for this purpose as soon as possible. It is a very characteristic Queen Anne house with a charming little garden.

The booklet will very shortly be available for all Fellows of the Society, and although it is addressed in particular to Buckinghamshire, it is hoped that the Fellows will endeavour to make the work and the Appeal as widely known as possible. The cost of the booklet will be defrayed by the sale of a number of copies autographed by the distinguished contributors. The Society feel that if they can succeed in giving new life to this little industrial village, it will have provided an object lesson which must have a lasting influence on the work of the preservation of England.



Arlington Row, Bibury, after restoration.

ARLINGTON ROW, BIBURY.

The restoration work here is now practically completed. The Society has received gratifying reports from the locality that the work has been well done and is much appreciated. It was always realised that the amount contributed would hardly meet the necessities of this rather derelict group of cottages, and when the surrounding ground has been tidied up and the stream in front of the cottages cleaned up, there will be a sum of £325 still to find. It is proposed to put a tablet on a small building as one approaches the cottages, indicating that they were restored by the Royal Society of Arts. It is hoped that early in the New Year some formal handing over of the property may be arranged. Meantime, any further contributions for this work would be very gratefully received.

NOTES ON BOOKS.

THE COTTAGES OF ENGLAND. By Basil Oliver. London: B. T. Batsford, Ltd. 21s.

This is an excellent book, well written, fully illustrated, with no sentimental emphasis. It appears at a good moment, when civilised people of both conservative and, as it were, progressive temperaments are uniting to defend a lovely part of our heritage from the indifferent speculator. Mr. Stanley Baldwin in his preface, and the author in the Introduction, make it quite clear (to those who are not already aware of the fact, as they should be), that the preservers of rural England are animated by no mere passion for the antique, and that they are in no sense the heirs of that famous gentleman who wanted his architect to build him "an ornamental building which should have the appearance of a convent, be partly in ruins and yet contains some weatherproof apartments."

It is desired to preserve our old cottages from the weather as well as from the pick. Their variety and their value can be studied in Mr. Oliver's book; and what a wonderful assemblage of photographs this is! All the English counties are represented, and therefore, all the manners of construction; cottages of stone and brick, and cottages with half timber framework. The geological map, Fig. 1, drawn by Mr. Sydney Jones, explains the distribution of styles. It shows the oolitic belt within which our most interesting stone cottages are to be found; this stretches from a point in Lincolnshire south-west to the coast of Dorset. It marks the chalk and timber regions, the limestone and sandstone shires of the north, and the granite of Cornwall.

To have a taste for old cottages we need not first be lovers of the Gothic. To the lover of the Classical styles old cottages appeal because their scale is human and their execution so often broad and spontaneous. Carried out, moreover, in local materials, they are apt to harmonise with their environment; their tones fuse with the rest of the picture; at any rate, they thrill the painter in us. But not seldom the architect also is satisfied; look at Wareham and Bibury, Castle Combe, Groombridge and Dinder, where the cottages are interestingly grouped. The photograph of Wareham from the air suggests intelligent planning—something more than grouping, an effect which is enhanced by the clear cut aspect of the stone houses, individually and in blocks.

The character of our English cottages ranges from the simple masculine to the simple feminine; in between we get a pleasant type that combines strength with grace. Generally speaking, Cornwall and the north give us the virile sort of cottage,

half timber and thatch produce the more feminine feeling, while some of the tile-hung houses of Kent have a quiet sophistication which is not too much "hundred per cent." one way or the other.

The work of the Committee of the Royal Society of Arts is becoming widely known and as widely appreciated. What is wanted is everywhere a sense of local patriotism, so to speak; a sense that the people of every neighbourhood should make themselves as far as possible responsible for the preservation of the old cottages that yet remain for their delight. Certainly it is absurd to resist the builders' encroachments unless the cottages that already stand are habitable. There is no room for a negative policy.

Mr. Oliver's book, the facts and illustrations he provides, should make every reader feel keenly the importance of the question in its larger aspects, and should make people want to come together and pursue a definite policy, presenting a united front to the vandal and the materialist. The cottagers themselves have often a lively interest in the beautiful and curious homes in which they live, and they are thus able to develop an æsthetic sense which it is very hard to inculcate in townsmen, accustomed from earliest childhood to contemplating a vulgar environment without horror.

GENERAL NOTE.

THE NINETEENTH ENGLISHWOMAN EXHIBITION OF ARTS AND HANDICRAFTS.—The well-known annual Englishwoman Exhibition of Arts and Crafts will be opened at 12 noon on Wednesday, November 13th, at the Central Hall, Westminster, and will remain open until Saturday, November 23rd (11 a.m. to 7 p.m. each day). The Exhibition, which is under very influential patronage, will comprise exhibits of almost every description of arts and crafts, including jewellery, pottery, weaving, wood-carving, furniture, leather work, printing and book-binding, silver and metal work, lampshades, embroidery, lace, toys, enamelled glass and a large variety of other articles. There will be daily demonstrations in pottery making, weaving, lace-making and other craft work.

MEETINGS OF THE SOCIETY BEFORE CHRISTMAS.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock (unless otherwise announced)

NOVEMBER 6 (8.30 p.m.)—Opening Meeting of the One-hundred-and-seventy-sixth Session. Inaugural Address by LLEWELYN B. ATKINSON, M.I.E.E., Chairman of the Council of the Society, on "Fifty Years of Electrical Science and Industry."

NOVEMBER 13.—J. O. BOVING, "New Developments in Hydraulic Pneumatic Engineering." CHARLES VERNON BOYS, F.R.S., will preside.

NOVEMBER 20.—P. MORLEY HORDER, F.S.A., "The Protection of Rural England."

NOVEMBER 27.—C. NORMAN KEMP, B.Sc., A.I.C., Secretary, Royal Scottish Society of Arts, "The Examination of Coal and Coke by X-Rays." (Dr. Mann Lecture). DR. FRANK S. SINNATT, F.I.C., M.I.Min.E., will preside.

DECEMBER 4.—HARRY H. PEACH, Hon. Secretary, Council for the Preservation of Rural England Exhibition Committee, "The Advertiser and the Disfigurement

of Town and Countryside: Criticisms and Suggestions." SIR LAWRENCE WEAVER, K.B.E., will preside.

DECEMBER 11.—MAJOR CHARLES WHEELER, O.B.E. (Mil.), M.I.A.E., formerly Chief Automobile Engineer of the General Post Office, "Overheads and other Factors influencing Road Transport Costs from an Engineer's Viewpoint." JOHN MAUGHFLING, C.A., will preside.

INDIAN SECTION.

Friday afternoons at 4.30 o'clock.

NOVEMBER 8.—A. M. GREEN, I.C.S., Acting Trade Commissioner for India, "The Indian Cinema Industry." DR. T. DRUMMOND SHIELS, M.C., M.P., Parliamentary Under-Secretary of State for India, will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock.

E. G. RICHARDSON, B.A., Ph.D., D.Sc. (Lecturer at University College), "Wind Instruments from Musical and Scientific Aspects." Three Lectures, November 18th, and 25th, December 2nd.

LECTURE I.—Sounds of pipes and methods of exciting them. Primitive pipes. The hydraulus and early organ pipes. The introduction of side holes. Precursors of the flute. Early reed pipes and reed instruments. The introduction of keys. Early brass instruments.

LECTURE II.—How the air is set in vibration in a flute and flue pipe. The formation of eddies. Edge-tones and their importance in the functioning of the flute. How a reed sets the air in vibration. The function of mouth pieces of brass instruments.

LECTURE III.—Effect of the shape, material and "scale" of the pipe. The modern flute. The clarinet, oboe and allied reed instruments. Brass instruments with pistons. The trombone.

Demonstrations will be given on the various instruments.

MEETINGS OF OTHER SOCIETIES DURING THE ENSUING WEEK.

MONDAY, NOVEMBER 11.—Abattoir Society, Model, at the Royal Society of Arts, Adelphi, W.C. 5.30 p.m. Brig-General Charteris, "The Provision and Control of Slaughterhouses." (Benjamin Ward Richardson Memorial Lecture).
Automobile Engineers, Institution of, at Queen's Hotel, Birmingham. 7 p.m. Dr. W. H. Hatfield, "Steels for Automobiles and Aeroplanes."
East India Association, at Caxton Hall, Westminster, S.W. 1.30 p.m. Mr. Waris Ameer Ali, "Preservation of Indian Fauna."
Electrical Engineers, Institution of, Savoy Place, W.C. 7 p.m. Discussion on "Temporary Expedients in Engineering." Opened by Mr. W. G. Highfield.
At Armstrong College, Newcastle-on-Tyne. 7 p.m. Lt.-Col. S. E. Monkhouse and Mr. L. C. Grant, "The Heating of Buildings Electrically by means of Thermal Storage."
At the University, Edmund Street, Birmingham. 7 p.m.

At the Merchant Venturer's Technical College, Bristol. Geographical Society, Lowther Lodge, Kensington Gore, S.W. 5 p.m. Papers on Stereographic Survey. Heating and Ventilating Engineers, Institution of, at the Borough Polytechnic, Southwark, S.E. 7 p.m. Debate, "Panel versus Direct Heating."
Metals, Institute of, at 30 Elmbank Crescent, Glasgow. 7.30 p.m. Mr. George Mortimer, "Some Difficulties in Aluminium Alloy Founding and some Remedies."
Photographic Society, 35 Russell Square, W.C. 7 p.m. Meeting of the Kinematograph Group.
Surveyors' Institution, 12 Great George Street, S.W. 8 p.m. Mr. C. H. Bedells, Presidential Address.
Transport, Institute of, at the Institution of Electrical Engineers, Savoy Place, W.C. 5.30 p.m. Annual General Meeting. Sir Henry Fowler, "Locomotive Repairs."
University of London, at King's College, Strand, W.C. 5.30 p.m. Rev. G. E. Newson, "The Church and the World. Lecture VI—The Modern Period."
At University College, Gower Street, W.C. 8 p.m. Mr. N. F. Hall, "England in Shakespeare's Day. Lecture V—Tudor Commerce and Industry."

TUESDAY, NOVEMBER 12. Automobile Engineers, Institution of, at the King's Head Hotel, Coventry. 7.30 p.m. Mr. J. Wallace, "The Super-Sports Motor Cycle."

Anthropological Institute, 52 Upper Bedford Place, W.C. 8.30 p.m. Mr. E. E. Evans-Pritchard, "Zande Witch-Doctors."

Electrical Engineers, Institution of, at the Hotel Metropole, Leeds. 7 p.m. Mr. E. J. Evans, "Feed Heating by extracted Steam in Generating Stations." At the Engineers' Club, Manchester. 7 p.m. Mr. R. A. Chattock, "The Modern Use of Pulverized Fuel in Power Stations." (Joint Meeting with the Institution of Mechanical Engineers).

At the Royal Technical College, Glasgow. 7.30 p.m. Mr. G. Morgan, Chairman's Address.

Eugenics Society, at Burlington House, W. 8 p.m. Dr. C. P. Blacker and Dr. W. W. Herbert, "Insanity."

Marine Engineers, Institute of, 85-88 The Minories, E.C. 6.30 p.m. Mr. J. Harbottle, "The Opposed Piston Oil Engine."

Metals, Institute of, at Armstrong College, Newcastle-on-Tyne. 7.30 p.m. Dr. Robert Hay, "Age Hardening in Alloys."

Petroleum Technologists, Institution of, at the Royal Society of Arts, Adelphi, W.C. 5.30 p.m. Lt.-Col. Sir Arnold T. Wilson, "Oil Legislation in Central and South America."

Quekett Microscopical Club, 11 Chandos Street, W. at 7.30 p.m. Mr. E. A. Robins, "Spiders; Notes on their Life and Habits."

University of London, at King's College, Strand, W.C. 5.30 p.m. Prof. Sir B. P. Farrer, "Russian History to 1861. Lecture V—Rise of Moscow."

King's College (at 40 Torrington Square), W.C. 5.30 p.m. Dr. J. Krzyzanowski, "The Polish Novel in the 19th Century. Lecture IV—Boleslas Prus and his Philosophy."

At University College, Gower Street, W.C. 6.30 p.m. Mr. E. T. Elbourne, "Engineering Management." (Lecture I).

WEDNESDAY, NOVEMBER 13. Anthropological Institute, at the Portland Hotel, Great Portland Street, W. 5.30 p.m. Sir A. Keith, "Race Building—Past and Present."

Arts, Royal Academy of, Burlington House, W. 4 p.m. Prof. Dr. A. P. Laurie, "Rembrandt and his Pupils. (Illustrated by magnified photographs)."

Civil Engineers, Institution of, Great George Street, S.W. 6 p.m. Mr. R. Moreland, "Developments in Structural Iron and Steelwork during the past 50 years."

Literature, Royal Society of, 2 Bloomsbury Square, W.C. 5 p.m. Mr. L. Housman, "The Spirit of Pre-Raphaelitism in Painting and Poetry."

Metals, Institute of, at Thomas's Cafe, High Street, Swansea. 7 p.m. Mr. W. E. Prytherch, "The Effect of some impurities in Copper."

Public Health, Royal Institute of, 37 Russell Square, W.C. 4 p.m. Dame A. Louise McIlroy, M.D., D.Sc., "The Influence of Pathology upon Maternal Welfare."

University of London, at King's College, Strand, W.C. 5.30 p.m. Prof. E. Wilson, "The Contribution of King's College to the Advancement of Learning during the Century 1829-1928. Lecture VI—Engineering." At the London School of Economics, Houghton Street, W.C. 6 p.m. Lecture VI on "Office Machinery."

At the Royal Veterinary College, Great College Street, N.W. 5.30 p.m. Major G. W. Dunkin, "Recent Researches on Immunization against Distemper in the Dog." (Lecture II).

At the School of Oriental Studies, Finsbury Circus, E.C. 5.15 p.m. Mr. H. R. Gibb, "Ibn Battuta."

At University College, Gower Street, W.C. 3 p.m. Dr. C. Pellizzi, "La Lirica del Paradiso." (Lecture II).

At University College, Gower Street, W.C. 5.30 p.m. Mr. I. C. Gröndall, "Some Norwegian Writers of the Present Day (Riksmål)." Lecture II.

THURSDAY, NOVEMBER 14. Electrical Engineers, Institution of, at University College, Dundee. 7.30 p.m. Mr. A. Erskine, "The Economic Combustion of Coal."

Historical Society, 22 Russell Square, W.C. 5 p.m. Mr. G. H. White, "King Stephen's Fiscal Exactions."

L.C.C., The Guildhall, Museum, Kingsland Road, E. 7.30 p.m. Mr. Stafford Ransome, "Wood-working Machinery."

Mechanical Engineers, Institution of, at the South Wales Institute of Engineers, Cardiff. 6.30 p.m. Address by Mr. H. D. Madden, Chairman of the Branch.

Metals, Institute of, at the Royal School of Mines, South Kensington, S.W. 7.30 p.m. Mr. H. Livingstone Sulman, "Mineral Flotation."

At the Chamber of Commerce, Birmingham. 7 p.m. Open Discussion on "Rolling."

North East Coast Institution of Engineers and Shipbuilders, at the Cleveland Institution, Middlesbrough. 7.30 p.m. Eng.-Capt. J. J. Sargent, "Notes on Practical Marine Engineering Problems."

University of London, at Bedford College for Women, Regent's Park, N.W. 4.30 p.m. Prof. Eclies, "Montaigne" (in French). Lecture VI.

At King's College, Strand, W.C. 5 p.m. Dr. W. Robson, "Protein Metabolism." (Lecture I).

At King's College, Strand, W.C. 5.30 p.m. Mr. I. L. Evans, "Austria in the Eighteenth Century." (Lecture I).

At King's College, Strand, W.C. 5.30 p.m. Prof. W. Ford, "Handel's Songs."

At King's College, Strand, W.C. 5.30 p.m. Col. C. G. Ling, "The Officers' Training Corps."

At King's College, Strand, W.C. 5.30 p.m. Dr. J. A. Williamson, "The Cabots and the Discovery of the New World." (Lecture I).

At University College, Gower Street, W.C. 5.15 p.m. Prof. J. H. G. de Montmorency, "Momentous Lawsuits and Trials in various Countries from Classical to Modern Times." (Lecture I).

At University College, Gower Street, W.C. 5.30 p.m. Prof. W. M. Dixon, "England, The Bible, and Shakespeare." (Lecture I).

Victoria and Albert Museum, South Kensington, S.W. 5.30 p.m. Mr. G. McN. Rushforth, "The Windows of a Medieval Church, and their Treatment as a Pictorial Scheme."

FRIDAY, NOVEMBER 15. Chemical Industry, Society of (Chemical Engineering Group), at the University, Nottingham. Mr. J. Arthur Reavell, "The Scientific Heating of Liquids and Gases."

Dyers and Colourists, Society of, at Manchester. Dr. F. A. Mason, "Peter Griess."

Electrical Development Association, at the Royal Society of Arts, Adelphi, W.C. 7.30 p.m. Mr. G. E. Sharp, "Selling Time Switches."

Fuel, Institute of, at University College, Nottingham. 7 p.m. Dr. J. W. Whitaker, "Coals and their Impurities."

Geologists' Association, at University College, Gower Street, W.C. 7.30 p.m. Special General Meeting.

London Society, at the Royal Society of Arts, Adelphi, W.C. 5 p.m. Mr. Lawrence Tanner, "Royal and Medieval Tombs of Westminster Abbey."

Mechanical Engineers, Institution of, Storey's Gate, S.W. 6 p.m. Mr. Francis Hodgkinson, "Journal Bearing Practice."

North East Coast Institution of Engineers and Shipbuilders, at the Mining Institute, Newcastle-on-Tyne. 6 p.m. Dr. B. C. Laws, "The Behaviour of a Cargo Vessel during a Winter North Atlantic Voyage."

University of London, at King's College, Strand, W.C. 5.30 p.m. Prince D. S. Minsky, "The Russian Drama. Lecture V—Contemporaries of Ostrovsky: Pisemsky and Tolstoy."

At King's College, Strand, W.C. 5.30 p.m. Prof. D. Saurat, "The French Novel. Lecture IV—Le roman de la race et du travail—Jean Richard Bloch."

At King's College for Household and Social Science, 61 Camden Hill Road, W. 5 p.m. Prof. V. H. Mottram, "Human Nutrition." (Lecture VI).

At the London School of Economics, Houghton Street, W.C. 5 p.m. Dr. H. Dalton, "The Foreign Office at Work."

At University College, Gower Street, W.C. 5.30 p.m. Prof. W. M. Dixon, "England, The Bible, and Shakespeare." (Lecture II).

At University College, Gower Street, W.C. 5.30 p.m. Sir Richard Lodge, "English Parties and Foreign Policy in the Eighteenth Century." (Lecture III).

SATURDAY, NOVEMBER 16. L.C.C. The Horniman Museum, Forest Hill, S.E. 3.30 p.m. Mr. H. Harcourt, "The Marvel of India's Canals."

INDEX TO VOL. LXXVII.

A

- dam, M.A., *disc.*, history of the development of fast-dyeing and dyes, 572
 Adashead, Professor S., *disc.*, modern English architecture, 704
 Agriculture, the improvement of Negro, *paper* by Lord Olivier, 396
 Air survey and Empire development, *paper* by Col. H. L. Crosthwait, 162
 ALDRID LECTURES:—Annual report, 820
 "Nomadic movements in Asia," by Sir E. Denison Ross, C.I.E., Ph.D., 1068, 1075, 1087, 1099.
 Ali, A. Yusuf, *disc.*, the Indian peasant in history, 615
 Alward, G. L., *letter*, Thomas Gray Memorial Trust, 392
 Architecture, modern English, *paper* by Professor A. E. Richardson, 696
 Armstrong, Sir Charles, *chair*, recent electrical progress in India, 764
 Armstrong, Professor H. E., F.R.S., *chair*, history of the development of fast dyeing and dyes, 568, 573
 Ashbourne, J., *disc.*, commercial art, 661
 Askwith, Lord, *chair*, building models, 768, 773
 Atkinson, L. B., *disc.*, the domestic smoke problem, 356; *disc.*, the Shannon scheme and its economic consequences, 492; *disc.*, some modern aspects of electrical communication, 920

B

- Baker, G. P., *disc.*, history of the development of fast dyeing and dyes, 570
 Barber, Dr. C. A., *disc.*, the Indian sugar industry, 152
 Barker, A. H., *disc.*, the domestic smoke problem, 357
 Barnes, Rt. Hon. G. N., *disc.*, museums and education, 387
 Barry, T. H., *disc.*, East Indian copals and damars, 594
 Base metal and mineral resources of South Africa, *paper* by H. Warington Smyth, 713
 Bather, F. A., F.R.S., *disc.*, museums and education, 389
 Beaumont, W. K., *disc.*, history of the development of fast dyeing and dyes, 572
 Beaumont, W. Worby, *obituary*, 619
 Bell, V. A., *disc.*, recent developments in educational broadcasting, 893
 Bhatia, H. R., *disc.*, recent electrical progress in India, 762
 Bishop, A. D., *disc.*, English silver and its future, 68
 Biles, Sir John H., *disc.*, fuel for ships, 221
 Blake, G. G., *paper*, applications of electricity to medical practice, 236, 263; *disc.*, loud speakers and their development, 693; silver medal awarded for his *paper*, 830
 Blakesley, T. H., *obituary*, 410
 Blythe, Dr. G. E. K., *disc.*, fuel for ships, 226
 Bompas, C. H., *disc.*, town water supply in India, 46; *disc.*, the history of the Royal Indian Marine, 539
 BOOKS, NOTES ON:—
 Adams-Acton Murray, Domestic architecture and old furniture, 839
 Appleton, W. A., unemployment: its cause and cure, 1110
 Arts and crafts year book and directory, 1929, 1022
 Bird, W. Hobart, Old Gloucestershire churches, 813

- Boswall, R. O., the theory of film lubrication, 709
 Bradley, H. and C. C. Hancock, modern roadmaking, 72
 Bragg, Sir William, F.R.S., The structure of an organic crystal, 265
 Brooks, C. E. P., and J. Glasspoole, British floods and droughts, 952
 Catalogues of wall papers, V. and A. Museum, 1112
 Cockerell, Douglas, Some notes on book-binding, 921
 County Anthologies; (1) Yorkshire, by G. F. Wilson; (2) Derbyshire, by T. Moul; (3) Lanarkshire, by H. Quigley, 1082
 Crenell, J. T. and F. M. Lea, Alkaline accumulations, 922
 Crooks, Maxwell, Touch typewriting for teachers, 207
 Cundall, H. M., A history of British water-colour painting, 897
 Desbieds, L. Blin, Exact colour matching and specifying, 308
 De Villamil, Lieut.-Col. Richard, Rational mechanics, 497
 Dodsworth, J. E., Charles Letts's Engineers diary, 264
 Driver, J. E., The chemistry of crude drugs, 22
 Fairchild, H. P., Immigrant backgrounds, 776
 Fletcher, Harvey, Speech and hearing, 1148
 Hartley, Dorothy and Margaret Elliot, Life and work of the people of England, 620
 Hastings, H. de C., Recent English domestic architecture, 1096
 Heaton, Noel, Outlines of paint technology, 471
 Hingston, Major R. W. G., Problems of instinct and intelligence, 307
 Holloway, R. S., American furniture and decoration Colonial and Federal, 840
 Holman, R. M., and W. W. Robins, Elements of Botany, 472
 Hooper, J., and A. J. Shirley, Handcraft in wood and metal, 842
 Huntingdon, E., and L. F. Whitney, The builders of America, 1147
 Johnson, A. F., French sixteenth century printing, 599
 Keane, C. A., and P. C. L. Thorne, Lunge and Keane's technical methods of chemical analysis, 2nd edition, 951
 Knights, C. and F. E. Norman, Commercial art practice, 22
 Kossel, Albrecht, The protamines and histones (trans. by W. V. Thorpe), 665
 Le Corbusier, The city of tomorrow (trans. by F. Etchells), 1060
 Le Page, W. L., The A.B.C. of flight, 306
 Lister, Walter, Practical steel making, 1131
 Littlejohns, J., Art in schools, 974
 Lloyd, Nathaniel, Building craftsmanship in brick and tile and in stone slated, 921
 Lyman, Theodore, The spectroscopy of the extreme ultra-violet, 363
 Mauseion, 1111
 Newton, A. P., and J. Ewing, The British Empire since 1783, 1130
 Nichols, J. B., Belis through the ages, 73
 Noble, Edwin, Animal drawing and anatomy, 541
 Oliver, Basil, The Cottages of England, 1195

- Pearce, A. S., and F. G. Hall, Homothermism, 1005
 Reithaler, Dr. Franz, Artificial silk (trans. by F. M. Rowe), 1097
 Reynolds, W. C., Atomic structure as modified by oxidation and reduction, 74
 Robson, P. A., Architecture as a career, 1133
 Slinger, C., A short history of medicine, 20
 Smithells, C. J., Impurities in metals: their influence on structure and properties, 182; tungsten, 798
 Stratton, A., The styles of English architecture, Part II, 1133
 Strzygowski, J., Early church art in Northern Europe, 765
 Taylor, P. H., The installation of electric lighting and heating, 604
 Todd, D., and B. Mortimer, The new interior decoration, 796
 Villiers-Stuart, C. M., Spanish gardens, 806
 Wall, E. J., Practical colour photography, 895
 Whitehouse, J. H., Creative education at an English public school, 736
 Woodhouse, Thomas, The finishing of jute and linen fabrics, 812
 Bosanquet, Captain H. T. A., *disc.*, the history of the Royal Indian Marine, 539
 Bosson, A. C., presentation of medal to, 19
 Bourne, R., *disc.*, air survey and Empire development, 180
 Bradshaw, P. V., *chair*, commercial art, 648, 680
 Bracker, Air Vice-Marshal Sir Sefton, *disc.*, air survey and Empire development, 181
 Brand, Engr.-Captain, *disc.*, fuel tor ships, 223
 British Industries fair, 442
 British industry, fifty years of, *address* by the Chairman of the Council, Sir George Sutton, Bt., 2
 Broadcasting, recent developments in educational, *paper* by H. L. Fletcher, 872
 Brough, T., *obituary*, 71
 Building models, *paper* by P. Morley Horder, 708
 Burgess, W. T., *disc.*, town water supply in India, 47
 Burn, Sir Richard, *disc.*, the Indian peasant in history, 618
 Burrell, Robert, *paper*, the reform of the British patent system, 923, 950; silver medal awarded for his *paper*, 830
 Burrows, F. W., *disc.*, commercial art, 662
 Burrows, Sir S. Montagu, presentation of medal to, 10
 Butcher, Miss A. Deane, *letter*, applications of electricity to medical practice, 392
 Byng, E. S., *disc.*, some modern aspects of electrical communication, 920

C

- CANTOR LECTURES:—*Notice* of publication of reprints, 50; 449; 1191; annual report, 828,
 1st Course:—"Biology and refrigeration," by Franklin Kild, M.A., D.Sc., 269, 288, 313
 2nd Course:—"The treatment of coal," by C. H. Lander, C.B.E., M.Inst.C.E., M.I.Mech.E., F.Inst.P., 955, 975, 987
 Chadwick, Sir David T., presentation of medal to, 19
 Chatterjee, Sir Atul, *disc.*, museums and education, 390
 Chatterton, G. K., *disc.*, annual meeting of fund for the preservation of ancient cottages, 452
 China, trade in the Hwai river basin, 1041
 Chivers, Cedric, *obituary*, 363
 Clarke, Captain Sir Arthur, *disc.*, the Port of London, 205;
Mann Juvenile Lectures, ships and lighthouses, 211, 285; *disc.*, the Shannon scheme and its economic consequences, 494; *disc.*, East Indian copals and damars, 596, 598; *disc.*, the properties and applications of "vita" glass, 810
 Clarke, E. J. B., *disc.*, the domestic smoke problem, 359
 Clements, Major R. G. H., presentation of medal to, 19
 Close, Col. Sir Charles, F.R.S., *disc.*, air survey and Empire development, 178
 Coal, the treatment of, *Cantor Lectures* by C. H. Lander, 955, 975, 987

- Cochran-Patrick, Major C. K., *disc.*, air survey and Empire development, 179
 Cohen, Captain B. S., *disc.*, loud speakers and their development, 692
 Coldstream, William, *obituary*, 664
 Commercial art, *paper* by Tom Purvis, 649
 Conway, Sir Martin, *disc.*, war and its influence on the arts, 795
 Cook, Miss C., *disc.*, recent developments in educational broadcasting, 894
 Cooper, A. T., *paper*, recent electrical progress in India, 739, 762; silver medal awarded for his *paper*, 830
 Cooper, F., *disc.*, the South African iron and steel industry, 516
 Copals and damars, East Indian, *paper* by A. F. Suter, 577
 Cope, Sir Alfred, *disc.*, the domestic smoke problem, 357, 358
 Cosgrove, Major J., *disc.*, forestry in Sweden, 94
 Cottages, fund for the preservation of ancient, annual general meeting, 450; report, 450; purchase of West Wycombe, 475; annual report, 831; West Wycombe and Arlington Row, 1191
 Council, 1928-29, 1; meetings of, 25, 137, 288, 367, 476, 575, 711, 783, 871, 1151; annual report, 834; 1929-30 elected, 837
 Cox, Major-Gen. Sir Percy, *disc.*, the history of the Royal Indian Marine, 537
 Craig, Cunningham, *disc.*, fuel for ships, 225
 Crawford and Balcarres, Karl of, F.R.S., *chair*, English silver and its future, 50, 65; *chair*, museums and education, 369
 Crosthwaite, Col. H. L., *paper*, air survey and Empire development, 162; silver medal awarded for his *paper*, 830

D

- Dalsiel, Dr. J. M., *disc.*, the improvement of Negro agriculture, 416
 Darling, Professor Charles R., *paper*, the domestic smoke problem—a practical solution, 346, 360
 Davidson, A., *disc.*, some modern aspects of electrical communication, 819
 Davis, F. W., *disc.*, the Port of London, 206
 Deck, Dr. E. J., *disc.*, the properties and applications of "vita" glass, 808
 Deffos, C. F., *disc.*, the South African iron and steel industry, 515
 Denman, R. P. G., *paper*, loud speakers and their development, 698
 De Villamil, Lieut.-Col. R., *letter*, rational mechanics, 598
 D'Eyncourt, Sir Eustace Tennyson, F.R.S., *paper*, fuel for ships, 212, 226, 228; silver medal awarded for his *paper*, 830
 Dibley, G. E., *disc.*, museums and education, 388
 DOMINIONS AND COLONIES SECTION:—Annual report, 826; committee meeting, 815
 1st Meeting:—"Air survey and Empire development," by Col. H. L. Crosthwaite, C.I.E., R.E., 161
 2nd Meeting:—"The improvement of Negro agriculture," by the Right Hon. Lord Olivier, P.C., K.C.M.G., C.B., LL.D., 396
 3rd Meeting:—"The South African iron and steel industry," by H. J. van der Byl, Ph.D., M.A.M.I.E.E., F.I.R.E., F.R.S. (S.A.), 500
 4th Meeting:—"The base metal and mineral resources of South Africa," by H. Warrington Smyth, C.M.G., M.A., F.G.S., 713
 Dore, Lieut.-Col. Alan, *disc.*, the South African iron and steel industry, 517
 Dowling, H. G., *disc.*, history of the development of fast dyeing and dyes, 571; *disc.*, commercial art, 668
 Dugdale, T. C., *disc.*, history of the development of fast dyeing and dyes, 571

- Duly, S. J., presentation of medal to, 19
 Dye, history of the development of fast dyeing and, *paper* by James Morton, 544
 Dykes, A. H., *disc.*, the reform of the British patent system, 947

E

- Edwards, W. H., F.R.S., *chair*, loud speakers and their development, 668, 690, 693
 Eckerley, Captain P.F., *disc.*, recent developments in educational broadcasting, 801
 Ednow, Dr. A., *disc.*, the properties and applications of "vita" glass, 810
 Electrical communication, some modern aspects of, *paper* by G. H. Nash, 900
 Electrical progress in India, recent, *paper* by A. T. Cooper, 739
 Electricity to medical practice, applications of, *paper*, by G. G. Blake, 236
 Estill, J. H., *paper*, the Port of London, 186
 Evans, A. T., *disc.*, East Indian copals and damars, 596
 Ewing, Sir J. Alfred, F.R.S., *Trueman Wood Lecture*, the vibrations of railway bridges: an example of co-operative research, 624; Albert Medal awarded to, 784, presented, 843
 Examinations, annual report, 834; report on, 1135
 Exhibitions of applied and decorative art, 158, 183, 303, 393, 443, 496, 777, 1005
 Exhibition, international, of commercial architecture, 707

F

- Foulkes, C. J., *disc.*, museums and education, 390; *paper*, war and its influence on the arts, 784, 796
 Finance, annual report, 835
 Financial statement for 1928, 779
 Flahenden, Dr. Margaret, *chair*, the domestic smoke problem—a practical solution, 354, 358
 Fitton, Hedley, *obituary*, 954
 Flax, a new era for, 231
 Fletcher, G., *paper*, the Shannon scheme and its economic consequences, 478, 495; *disc.*, recent developments in educational broadcasting, 894
 Fletcher, H. L., *paper*, recent developments in educational broadcasting, 872, 894
 Forestry in Sweden: its importance to and influence on Great Britain; *paper* by Professor E. P. Stebbing, 78
 Fox, E. J., *disc.*, the South African iron and steel industry, 516
 Fraser, J. C., *disc.*, the South African iron and steel industry, 514
 Frost, Miss Marian, *disc.*, museums and education, 389
 Fruit growing, the flowering and pollination of fruit blossoms applied to commercial, *paper* by Cecil H. Hooper, 424
 Fuel for ships, *paper* by Sir Eustace Tennyson D'Eyncourt F.R.S., 212

G

- Gair, Sir Edward A., presentation of medal to, 19
 Garton, U. G., *disc.*, loud speakers and their development, 691
 Giles, Godfrey, *disc.*, modern English architecture, 705
 Gill, G. B., *disc.*, recent electrical progress in India, 760
 Gill, H. A., *disc.*, the reform of the British patent system, 945
 Gordon, J. W., *disc.*, the reform of the British patent system, 944
 Grainger, H., *disc.*, the flowering and pollination of fruit blossoms, 439

- Gregory, Sir Richard, *disc.*, recent developments in educational broadcasting, 898
 Griffin, J. G., *disc.*, recent electrical progress in India, 762
 Gubbay, M. M. S., presentation of medal to, 19

H

- Haddick, Lieut.-Col. V. A., *disc.*, the Shannon scheme and its economic consequences, 495
 Haden, G. N., *disc.*, the domestic smoke problem, 358
 Hall, Sir Daniel, F.R.S., *abstract* of a paper read before the Royal Institution on the garden tulip, 1039
 Harbord, F. W., *disc.*, the South African iron and steel industry, 513
 Haycroft, H. C., *disc.*, the reform of the British patent system, 945
 Haydon, Dr. A., *disc.*, the reform of the British patent system, 947
 Headlam, Captain Sir Edward J., *paper*, the history of the Royal Indian Marine, 520
 Heaton, Noel, *disc.*, East Indian copals and damars, 595
 Henderson, Dr. J. A. L., *disc.*, the South African iron and steel industry, 516
 Hettinger, J., *disc.*, the reform of the British patent system, 947
 Hill, Dr. A. W., F.R.S., *chair*, the improvement of negro agriculture, 396, 413
 Hill, Professor Leonard E., F.R.S., *chair*, the properties and applications of "vita" glass, 807
 Hoare, A. H., *disc.*, the flowering and pollination of fruit blossoms, 440
 Hodgson, J., *disc.*, modern English architecture, 705
 Holland, Sir Thomas H., F.R.S., *chair*, air survey and Empire development, 161, 175
 Hooper, C. H., *paper*, the study of the order of flowering and pollination of fruit blossoms applied to commercial fruit growing, 424, 441; silver medal awarded for his *paper*, 830
 Hopwood, Dr. A., *disc.*, history of the development of fast dyeing and dyes, 573
 Horder, P. Morley, *paper*, building models, 768
 Hughes, G. R., *disc.*, English silver and its future, 67
 Hume, Captain C.W., *disc.*, the reform of the British patent system, 946
 Hutchison, W. F., *disc.*, the improvement of negro agriculture, 415
 Hydro-electric Power Commission of Ontario, by A. Lennox Stanton, 1115

I

- Indian Marine, the history of the Royal, *paper* by Captain Sir Edward J. Headlam, 520
 Indian peasant in history, the, *paper*, by W. H. Moreland, 605
 INDIAN SECTION. Committee meeting 815; annual report, 824; list of committee, 603
 1st Meeting:—"Town water supply in India," by J. W. Madley, M.A., M.Inst.C.E., M.Inst.W.E., 27
 2nd Meeting:—"The Indian sugar industry," by Sir James MacKenna, C.I.E., 130
 3rd Meeting:—"The history of the Royal Indian Marine," by Captain Sir Edward J. Headlam, C.S.I., C.M.G., D.S.O., R.I.M., 519
 4th Meeting:—"The Indian peasant in history," by W. H. Moreland, C.S.I., C.I.E., 604
 5th Meeting:—"Recent electrical progress in India," by A. T. Cooper, M.Inst.C.E., M.I.Mech.E., M.I.E.E., M. Cons. E., 739
 6th Meeting:—(Sir George Birdwood Memorial Lecture) "An outline of the history of medicine in India," by Captain P. Johnston-Saint, M.A., F.R.S. (Edn.), 843

Industrial designs, annual competition of, report on, 1928, 102; *notices*, 843, 848, 767, 899, 975 (visit of H.M. the Queen to exhibition); local exhibitions, 1075; annual report, 833; report on, 1929, 1152

Industrial maladies, thirty years' experience of, *Shaw Lectures* by Sir Thomas Morison Legge, 1007, 1023, 1043
Iron and steel industry, the South African, *paper* by H. J. van der Byl, 500

J

Jack, Brig.-Gen. E. M., *disc.*, air survey and Empire development, 180

Jaffé, A., *disc.*, the reform of the British patent system, 946

Jeanes, Sir James H., F.R.S., presentation of medal to, 19
Jhalawar, H.H. Sir Bhawani Singh Bahadur, Maharaj Rana, of, *obituary*, 775

Johnston-Saint, Captain P., *Sir George Birdwood Memorial Lecture*, an outline of the history of medicine in India, 844

Jones, Dr. T., *disc.*, history of the development of fast dyeing and dyes, 572

Jordan, Dr. L. A., *chair*, East Indian copals and damars, 593

Journal, *notice* of covers for, 28

K

Keeling, Sir Hugh T., *chair*, town water supply in India, 45
Kenyon, Sir Frederic, *disc.*, museums and education, 386

Keyser, L. B., *obituary*, 765

Kidd, Franklin, *Cantor Lectures*, 269, 288, 313

Kilburn, B.E.D., *disc.*, the reform of the British patent system, 946

Kirkpatrick, Sir Cyril, *disc.*, the Port of London, 205

Kupferburger, Dr. W., *disc.*, the base metal and mineral resources of South Africa, 734

L

Lamplough, F. E., *paper*, the properties and applications of "vita" glass, 799, 808, 811

Lander, C. H., *Cantor Lectures*, the treatment of coal, 955, 975, 987

Lane, Captain R. W., presentation of medal to, 19

Langley, L. C., *disc.*, commercial art, 663

Larke, Sir William J., *chair*, the South African iron and steel industry, 512

Lawn, Professor J. G., *chair*, the base metal and mineral resources of South Africa, 713, 731

Lawrence, Sir Henry S., *disc.*, the Indian sugar industry, 154; *disc.*, the Indian peasant in history, 614

Legge, Sir Thomas M., *Shaw Lectures*, thirty years' experience of industrial maladies, 1007, 1023, 1043

Leggett, Major Sir Humphrey, *disc.*, the South African iron and steel industry, 518

Library, books presented to, 1003

Liechtenstein, H.H. Prince John II of, *obituary*, 391

Lindsay, H. A. F., *disc.*, the Indian sugar industry, 155

Lodge, Sir Oliver J., F.R.S., *chair*, applications of electricity to medical practice, 261, 263, 264

London, the Port of, *paper* by J. H. Estlin, 186

Loud speakers and their development, *paper* by R. P. G. Denman, 668

Lowry, George A., a new era for flax, 231

Lynas, Col. Sir Henry, F.R.S., *disc.*, museums and education, 386

M

Macara, Sir Charles W., *obituary*, 231

MacDonald, Rt. Hon. J. Ramsay, M.P., *chair*, annual general meeting of the fund for the preservation of ancient cottages, 450, 458

MacKenna, Sir James, *paper*, the Indian sugar industry, 140, 156

MacLagan, Sir Edward D., *chair*, the Indian peasant in history, 604, 613

MacLagan, Eric, *disc.*, museums and education, 387

Madeley, J. W., *paper*, town water supply in India, 27

MANN JUVENILE LECTURES:—*Notices*, 77; annual report, 828; "Ships and lighthouses," by Captain Sir Arthur Clarke, K.B.E., 211, 235

Mant, Sir Reginald, *chair*, the Indian sugar industry, 139

Marsh, Arnold, *disc.*, the domestic smoke problem, 859

Marten, John T., *obituary*, 786

Matthews, R. B., *disc.*, the Shannon scheme and its economic consequences, 494

Mearns, J. W., *disc.*, recent electrical progress in India, 79

MEDALS:—

Albert, list of awards, 448; awarded to Sir J. Alfred Ewing, F.R.S., 784; annual report, 829; presentation to Sir Alfred Ewing, F.R.S., 843

Society's silver medals for *papers* read in 1927—season, presented, 19; 1928—29 awarded, annual report, 830

Medicine in India, an outline of the history of, *Sir George Birdwood Memorial Lecture* by Captain P. Johnston-Saint, 844

MEETINGS OF THE 175TH SESSION:—

ALDERD LECTURES (see "Aldred")

ANNUAL GENERAL MEETING, *notice* 783; report, Meeting, 816

CANTOR LECTURES (see "Cantor")

DOMINIONS AND COLONIES SECTION (see "Dominions")

INDIAN SECTION (see "Indian")

MANN JUVENILE LECTURES (see Mann)

SIR GEORGE BIRDWOOD MEMORIAL LECTURE (see "Sir George Birdwood")

SHAW LECTURES (see "Shaw")

TRUENMAN WOOD LECTURES (see "Trueman Wood")

MEETINGS, ORDINARY:—Annual Report, 816

1st Meeting:—(*Chairman's Address*), "Fifty years of British Industry," by Sir George Sutton, Bt., 2

2nd Meeting:—"English silver and its future," by Omar Ramsden, R.M.S., 50

3rd Meeting:—"Forestry in Sweden: its importance, to and influence on Great Britain," by Professor E. F. Stebbing, M.A., F.L.S., F.R.S.E., 78

4th Meeting:—"The Port of London," by J. H. Estlin, O.B.E., 185

5th Meeting:—"Fuel for ships," by Sir Eustace Tennyson D'Eyncourt, K.C.B., D.Sc., LL.D., F.R.S., 212

6th Meeting:—"Applications of electricity to medical practice," by G. G. Blake, M.I.E.E., F.Inst.P., 236

7th Meeting:—"The domestic smoke problem—a practical solution," by Professor Charles H. Darling, A.R.C.Sc.I., F.I.C., F.Inst.P., 345

8th Meeting:—"Museums and education," by Sir Henry A. Miers, M.A., D.Sc., F.R.S., F.G.S., F.C.S., 369

9th Meeting:—"The Shannon scheme and its economic consequences," by George Fletcher, M.A., F.G.S., M.R.I.A., 478

10th Meeting:—(*Trueman Wood Lecture*) "The vibrations of railway bridges: an example of co-operative research," by Sir J. Alfred Ewing, K.C.B., M.A., LL.D., D.Sc., F.R.S., h.Inst.C.E., 624

11th Meeting:—"The study of the order of flowering and pollination of fruit blossoms applied to commercial fruit growing," by Cecil H. Hooper, F.L.S., M.R.A.C., F.S.I., 424

12th Meeting:—"History of the development of fast dyeing and dyes," by James Morton, 544

13th Meeting:—"East Indian copals and damars," by A. F. Suter, 577

14th Meeting:—"Commercial art," by Tom Purvis, 648

15th Meeting:—"Loud speakers and their development," by R. P. G. Denman, M.A., A.M.I.E.E., 668

- Silver, English, and its future, *paper* by Omar Ramsden, 51
 Simon, Trevor B., *obituary*, 48
 Sinha, J. C., *disc.*, the Indian sugar industry, 155
Sir George Birdwood Memorial Lecture, an outline of the history of medicine in India, by Captain P. Johnston-Saint, 844
 Skelton, Robert, *obituary*, 707
 Skirne, F. H., *disc.*, the Indian sugar industry, 155
 Smith, F. Parker, *disc.*, forestry in Sweden, 94
 Smith, J. C., *disc.*, East Indian copals and damars, 596
 Smith, T., *disc.*, recent developments in educational broadcasting, 893
 Smoke problem, the domestic—a practical solution, *paper* by Professor Charles R. Darling, 345
 Smyth, H. Warington, *paper*, base metal and mineral resources of South Africa, 713, 735
 South Africa, base metal and mineral resources of, *paper* by H. Warington Smyth, 713
 South African iron and steel industry, *paper*, by H. J. van der Byl, 500
 Stanton, A. Lennox, the Hydro electric Power Commission of Ontario, 1115
 Stebbing, Professor E. P., *paper*, forestry in Sweden: its importance to and influence on Great Britain, 78, 96
 Stevens, Theodore, *disc.*, the Shannon scheme and its economic consequences, 494
 Steward, W. A., *disc.*, English silver and its future, 70
 Story, Professor Fraser, *disc.*, forestry in Sweden, 95
 Stuart-Williams, S. C., presentation of medal to, 19
 Sugar industry, the Indian, *paper* by Sir James MacKenna, 140
 Summerscales, J., *disc.*, the improvement of Negro agriculture, 415
 Suter, A. Y., *paper*, East Indian copals and damars, 577, 596, 597
 Sutton, Sir George, Bt., *chairman's Address*, 2; *disc.*, annual general meeting of the fund for the preservation of ancient cottages, 458
 Swedish Minister, H.E. the, *chair*, forestry in Sweden, 93, 97
 Swinburne, J., F.R.S., *chair*, the Shannon scheme and its economic consequences, 478; *chair*, the reform of the British patent system, 949
 Swinburne, Major U. P., *disc.*, base metal and mineral resources of South Africa, 733
 Swiney prize, award of, 267
 Swinton, A. C., F.R.S., *disc.*, fifty years of British industry, 20; *disc.*, applications of electricity to medical practice, 201
 Switzerland, water power in, 986

T

- Taylor, H. V., *chair*, the flowering and pollination of fruit blossoms, 438, 441
 Taylor, W., presentation of medal to, 19
 Taylor, W. L., *disc.*, forestry in Sweden, 96
 Telegraphy and telephony, some modern aspects of electrical communication: Advances in, *paper* by G. H. Nash, 900
 Thomas Gray Memorial Trust, *notice* of prizes for invention and essay, 311; award of prizes, 477; annual report, 832
 Thorp, J. B., *disc.*, building models, 774
 Thurston, A. P., *disc.*, the reform of the British patent system, 952
 Tipfield, T. M., *disc.*, recent developments in educational broadcasting, 893
 Tipping, H. Ayray, *disc.*, annual general meeting of the fund for the preservation of ancient cottages, 454

- Tizard, H. T., F.R.S., *disc.*, history of the development of fast dyeing and dyes, 570
 Towler, E. E., *disc.*, the reform of the British patent system, 948
 Town water supply in India, *paper* by J. W. Madeley, 624
 Trench, E. F. C., *chair*, the vibrations of railway bridges: an example of co-operative research, 624, 645
 Trevor, Major T. G., *disc.*, base metal and mineral resources of South Africa, 732
 Trueman Wood Lecture, the vibrations of railway bridges: an example of co-operative research, by Sir Ewing, F.R.S., 624
 Tulp, the garden, *abstract* of a paper read before Institution by Sir Daniel Hall, F.R.S., 1039

V

- van der Byl, H. J., *paper*, the South African iron and steel industry, 500, 517; silver medal awarded for his *paper*, 830
 Vaughan, Dr. Kathleen, *disc.*, the properties and applications of "vita" glass, 809
 "Vita" glass, the properties and applications of, 1 by F. E. Lamplough, 799

W

- Wake, Admiral Sir Drury St. A., *disc.*, the history of the Royal Indian Marine, 537
 Wakefield, Sir Charles, Bt., *disc.*, annual general meeting of the fund for the preservation of ancient cottages, 458
 Waldram, P. J., *disc.*, the properties and applications of "vita" glass, 809
 Wallas, Professor Graham, *disc.*, museums and education, 388
 War and its influence on the arts, *paper* by Charles I. Ward, 784
 Ward, L., *disc.*, the properties and applications of glass, 810
 Ware, Sir Fabian, *disc.*, annual general meeting of the fund for the preservation of ancient cottages, 456
 Water supply, town, in India, *paper* by J. W. Madeley, 624
 Whayman, Engr.-Rear-Admiral W. M., *disc.*, fuel for ships, 225
 Whipple, Dr. F. J. W., *disc.*, some modern aspects of electrical communication, 919
 Wibberley, Professor T., *disc.*, the Shannon scheme and its economic consequences, 491
 Wiles, Rt. Hon. Thomas, *chair*, the Port of London, 185, 207
 Wilkinson, Hargreaves, *disc.*, museums and education, 390
 Williams, J. G., *disc.*, history of the development of fast dyeing and dyes, 571
 Wilson, Lieut.-Col. Sir Arnold T., *disc.*, the domestic smoke problem, 380; *disc.*, annual general meeting of the fund for the preservation of ancient cottages, 455; *disc.*, the history of the Royal Indian Marine, 538; *chair*, modern English architecture, 605, 704, 706
 Wilson, G. F., *disc.*, the flowering pollination of fruit blossoms, 439
 Wilson, P., *disc.*, loud speakers and their development, 693
 Winterbotham, Col. H. St. J., *disc.*, air survey and Empire development, 178
 Wood, Sir Henry Trueman, *obituary*, 228
 Woodeson, W. E., *disc.*, fuel for ships, 224
 Wright, C. H., presentation of medal to, 19

